Engineering Library

DEC 4 1930

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VOL. CL.—No. 3906] LONDON: FRIDAY EVENING, NOVEMBER 21, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
SEVENTEEN LOCOMOTIVES with TENDERS, XA Type.
Tenders due 9th December, 1930.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 6108

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POST :—
M/2486.—ASSISTANT WATERWORKS ENGINEER REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for one tour of not less than 12 nor more than 18 months' service in the first instance. Salary £480 a year for the first three years, then £510, rising by annual increments to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages liberal leave on full salary. Candidates 25 to 35 years of age, must have passed sections A and B of the examinations to qualify for the A.M.I.C.E. diploma, or hold professional qualifications recognised by the Institution as exempting from those examinations. Must have had two years' practical engineering experience in Water Works Construction.
Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/2486. 6126

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
6105 Newcastle-upon-Tyne.

UNIVERSITY OF DURHAM.
Armstrong College, Newcastle-upon-Tyne.
LECTURESHIP IN CIVIL ENGINEERING.
The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in CIVIL ENGINEERING. Salary, £300 to £350, according to qualifications. Candidates must have had practical experience and have a good knowledge of Surveying. Preference will be given to candidates between the ages of 25 and 35. Duties to commence as soon as possible. Ten copies of applications and of not more than three testimonials should be lodged, not later than Monday, 8th December, 1930, with the undersigned, from whom further particulars may be obtained.
J. Y. T. GREIG,
Registrar,
6128 Armstrong College.

Lancashire Education Committee.
ASHTON-UNDER-LYNE JUNIOR TECHNICAL SCHOOL.

WANTED, an ASSISTANT MASTER, Graduate in Engineering, with works experience, capable of taking Experimental Physics. The Master appointed will be expected to take an active part in the corporate life of the School.
Further particulars and forms of application may be obtained on receipt of stamped addressed foolscap envelope from the undersigned.
G. W. HANDFORTH.
Education Office,
8, Warrington-street,
Ashton-under-Lyne. 6101

Port of Bristol Authority.
EASTERN ARM EXTENSION, ROYAL EDWARD DOCK, AVONMOUTH.
ALTERATIONS AND ADDITIONS TO DUST REMOVAL PLANT IN CONNECTION WITH GRAIN HANDLING MACHINERY.
The Port of Bristol Authority is prepared to receive TENDERS for ALTERATIONS and ADDITIONS to the DUST REMOVAL PLANT in connection with the GRAIN HANDLING MACHINERY at the Eastern Arm Extension of the Royal Edward Dock, Avonmouth.
On and after Wednesday, the 26th November, 1930, copies of the specification and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £2 has been paid. ALL CHEQUES MUST BE MADE PAYABLE TO "THE PORT OF BRISTOL AUTHORITY" and forwarded to the Secretary, Port of Bristol Authority, Docks Office, 19, Queen square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of a Tender with all the prescribed documents.
Tenders must be enclosed in a sealed envelope, endorsed "Tender for Alterations and Additions to Dust Removal Plant," addressed to the Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 22nd day of December, 1930.
The Port Authority does not bind itself to accept the lowest or any Tender.
THOMAS A. PEACE,
Chief Engineer.
Chief Engineer's Office,
Avonmouth Docks, Bristol,
21st November, 1930. 6109

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

New Lifting-Span Bridge at Great Yarmouth. (P. 558)
THE ENGINEER, 21 - 11 - 30.

Heating and Drying of Granular Materials No. III. (P. 574)
(W. GILBERT.) THE ENGINEER, 21 - 11 - 30.

ireless Development in Canada. (P. 561)
THE ENGINEER, 21 - 11 - 30.

Railway Electrification in Italy. (P. 571)
THE ENGINEER, 21 - 11 - 30.

Tubes for High-Pressure Water-tube Boilers. (P. 566)
(S. F. DOREY.) THE ENGINEER, 21 - 11 - 30.

Engineering in Germany. (P. 571)
THE ENGINEER, 21 - 11 - 30.

Side Wind and the Resistance of Trains. (P. 560)
(C. F. DENDY MARSHALL.) THE ENGINEER, 21 - 11 - 30.

Totally Enclosed Induction Motors. (P. 578)
THE ENGINEER, 21 - 11 - 30.

Air-Cooled Mechanical Stoker. (P. 576)
THE ENGINEER, 21 - 11 - 30.

INDEX TO ADVERTISEMENTS, PAGE 83.

PUBLIC NOTICES

County of London.
SUPPLY OF TRAMWAY RAILS, &c., 1931-32.
The London County Council invites TENDERS for the SUPPLY and DELIVERY in London of :—
(1) SECTION A.—About 5230 TONS of TRACK RAILS and FISH-PLATES.
SECTION B.—About 30 TONS of BOLTS and NUTS.
(2) About 800 TONS of CONDUCTOR TEE RAILS.
(Tenders will be considered for separate sections.)
The specifications, forms of Tender, drawings, &c., may be obtained on application to the General Manager of the Council's Tramways, 25, Belvedere-road, S.E. 1, upon payment of the sum of £2 in each case, i.e., (1) and (2), by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee. Correspondence and remittances by post should be addressed to the General Manager of the Council's Tramways, 25, Belvedere-road, S.E. 1, or personal application may be made to Room 222 at the above address in respect of item (1), Section A and B, and to Room 202 in respect of item (2).
Contractors will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and forms of contract and in "The London County Council Gazette."
No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 8th December, 1930, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
6103 Clerk of the London County Council.

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for :—
9000 LINEAL YARDS NAVY SAIL CANVAS.
Tenders are due in on Tuesday, 9th December, 1930, by 2 p.m. Tender form obtainable at address below, fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender.
Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 6111

PUBLIC NOTICES

East Lothian County Council.
DUNGLASS BY-PASS ROAD AND BRIDGE.
CONTRACT FOR WORKS.
The County Council of East Lothian is prepared to receive TENDERS for a DIVERSION of the MAIN EDINBURGH-BERWICK ROAD (A.1), about 1 mile and 1 long, near Cockburnspath, and a REINFORCED CONCRETE BRIDGE over DUNGLASS GORGE.
Under the contract 25 per cent. of the labour employed must be drawn from distressed areas and engaged through the Local Employment Exchange.
The drawings, specifications and schedules of quantities may be seen at the office of Messrs. Blyth and Blyth, Civil Engineers, 135, George-street, Edinburgh, on and after Monday, November 24th, 1930. Copies of the specification and duplicate copies of the schedule of quantities and form of Tender may be obtained from them on depositing £10. Cheques to be made payable to the County Council of East Lothian.
An engineer will meet contractors at Dunglass, East Lodge, at 11.30 a.m. on Thursday, 27th November, to show them the site of the works.
Sealed Tenders, marked on the outside "Tender for Dunglass By-pass Road and Bridge Contract," must be lodged with the undersigned not later than first post on Monday, December 15th, 1930.
The Council do not bind themselves to accept the lowest or any Tender.
GEO. CRUICKSHANK,
County Clerk.
County Buildings, Haddington,
13th November, 1930. 6095

The Bengal and North-Western RAILWAY COMPANY, LIMITED.
THE ROHILKUND AND KUMAON RAILWAY COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
23 LOCOMOTIVE ENGINES and TENDERS, as per specification to be seen at the Company's offices.
Tenders, addressed to the undersigned and marked "Tender for Locomotives," with name of firm tendering, to be lodged not later than Noon on the 16th day of December, 1930.
For the specification a fee of £2 will be charged, which cannot under any circumstances be returned.
The Directors do not bind themselves to accept the lowest or any Tender.
By Order of the Board,
W. R. IZAT,
Managing Director.
Secretary.
237, Gresham House, Old Broad-street,
London, E.C. 2, 18th November, 1930. 6100

PUBLIC NOTICES

Administrative County of LONDON.
The London County Council invites TENDERS for the PURCHASE and REMOVAL of the undermentioned PUMPING MACHINERY at Deptford Pumping Station, viz.:—
A Six-cylinder 3-Crank Vertical Compound Pumping Engine complete with Condensing Plant and having Three 15in. and Three 30in. Steam Cylinders, and Three Single-acting Pumps, 4ft. diameter, and all of 4ft. stroke; also a Circulating Water Pumping Set, Hydraulic Pumping Engine, Pipes, Girders, &c.
The specification, form of Tender, &c., may be obtained on and after Friday, 21st November, 1930, on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars may be obtained on personal application, and the contract documents may be inspected before payment of the fee.
Remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in "The London County Council Gazette."
No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 8th December, 1930, will be considered.
The Council does not bind itself to accept the highest or any Tender.
MONTAGU H. COX,
6102 Clerk of the London County Council.

South Indian Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
(1) TWO LOCOMOTIVE BOILERS for "N" Class Saturated Engines, Metre Gauge.
(2) CARRIAGE FITTINGS.
Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotive Boilers," or as the case may be, with the name of the firm tendering, must be left with the undersigned not later than 12 Noon on Friday, the 5th December, 1930.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of 10s. for each of copy Specification No. 1 and of 5s. for each copy of Specification No. 2.
Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.
A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1,
19th November, 1930. 6125

City of Nottingham.
WATER DEPARTMENT.
ENGINEERING ASSISTANT.
The Water Committee REQUIRE the SERVICES of an ENGINEERING ASSISTANT, not exceeding 35 years of age.
Candidates must be qualified Engineers, good Draughtsmen and Surveyors. Previous experience in a Waterworks Engineer's Office is essential.
The commencing salary of £300, less 5 per cent. for superannuation, will be in accordance with Grade C. (Prof.) of the City Council's Grading Scheme.
The appointment will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination.
Forms of application may be obtained from Mr. F. W. Davies, Engineer and General Manager, Castle Waterworks, Castle Boulevard, Nottingham.
Applications, in candidates' own handwriting, should be accompanied by copies of three recent testimonials, and delivered to me not later than Noon on Monday, the 15th December, 1930.
W. J. BOARD,
Town Clerk.
Guildhall, Nottingham,
19th November, 1930. 6129

Union of South Africa.
DIRECTOR FOR FUEL RESEARCH INSTITUTE.
APPLICATIONS are INVITED for the above DIRECTORSHIP.
ENGAGEMENT.—In the first instance for a period of three years.
SALARY.—£1000 with two increments of £100 to £1200 per annum maximum.
Applications, with copies of testimonials, all in triplicate, must reach the SECRETARY, Office of the High Commissioner for the Union of South Africa, 73, Strand, W.C. 2 (from whom application forms and further particulars may be obtained), not later than December 15th, 1930. 6093

SITUATIONS OPEN Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 84.
MISCELLANEOUS, Page 2.
EDUCATIONAL, Page 2.
MACHINERY, &c., WANTED, Page 84.
PARTNERSHIPS, Page 2.
PATENTS, Page 2.
FOR SALE, Pages 2 and 84.
BUSINESSES and PREMISES (For Sale, etc.). Page 84.
AGENCIES, Page 2.
WORK WANTED, Page 2.
FOR HIRE, Page 2.

For Advertisement Rates see Leader Page.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ENGINEER to Act as COMPRESSED AIR INSPECTOR for a group of Collieries in South Wales.
Experience of underground conditions essential, also of Testing Apparatus and in the use of Compressed Air Apparatus in use underground.
Applicant to state full experience, age, salary required, and give references.
Address, 6082, The Engineer Office. 6082 A

ASSISTANT RAILWAY ENGINEER REQUIRED, not over 35 years of age, for a foreign railway. A knowledge of Spanish essential. Salary 250.00 United States dollars per month, with house and travelling expenses.—Write to "A. M. R.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 6119 A

INDIA.—MACHINERY IMPORTERS REQUIRE efficient SALES ENGINEER for Steam Engines, Power Plant in general, Mill Gearing, Pumps, &c.
Preference will be given to one who can handle other kinds of machinery in addition to above and who can procure sole agencies.
Useless applying without selling experience.
Remuneration, salary and commission. State age.
Address, 6073, The Engineer Office. 6073 A

OUTSIDE REPRESENTATIVE for Constructional Engineers in South, with thorough knowledge of Structural Steel Work. Commercial experience desirable, but not essential, but applicants must be of good appearance and address.—Reply, stating age, qualifications, and salary required, to JAMES SMITH, Hamworthy, Poole, Dorset. 6116 A

SMART JUNIOR ESTIMATOR REQUIRED in S.W. London district. A good opening for a keen man with D.O. and works experience. State age, experience and salary.—Address, P516, The Engineer Office. P516 A

SMART YOUNG SALES ENGINEER REQUIRED by well-known Midland Firm to work the area in that district. Sound mechanical engineering essential. Not over 30.
Application must state fully education, experience, and salary required.
Address, 6074, The Engineer Office. 6074 A

THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., REQUIRE the SERVICES of TWO YOUNG ENGINEERS (age 20 to 25), with some knowledge of Reinforced Concrete or Constructional Engineering, to train for positions of Junior Representatives.
Previous commercial experience not essential, but applicants must be of good appearance and address and have an aptitude for the commercial side of business.
Applications, marked "Junior Representatives," should be addressed to SECRETARY, Lichfield-road, Stafford. 6104 A

DETAILING DRAUGHTSMAN REQUIRED for Constructional Steel Works in North London. Must be able to prepare shop drawings with minimum supervision and be familiar with Steel Frame (1909 Act) Buildings.
Address, stating age, experience, and salary required, P514, The Engineer Office. P514 A

DRAUGHTSMAN REQUIRED, with Thorough technical and practical experience in Agricultural Tractor or Automobile Design. State age and give full particulars of qualifications.—Address, 6106, The Engineer Office. 6106 A

EXPERIENCED DRAUGHTSMAN WANTED in the North of England for High-speed Heavy-oil Engine Work.—Apply, giving full particulars and experience and salary required, to Box 1182, c/o Brown's, 39, Tothill-street, S.W. 1. 6127 A

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TEMPORARY DRAUGHTSMAN, with Workshop experience, REQUIRED in London area for general engineering drawing. Salary at current bonus rate, £4 9s. 8d. for a 42-hour week. Preference given to ex-Service men.—Write, "P. E.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 6096 A

WANTED for Indian Railway, ASSISTANT BOILER FOREMAN; 5 years' agreement, passage, housing and medical attendance free; commencing salary Rs. 450.—Write, giving qualifications and experience, to B. D., c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 6090 A

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham, REQUIRE the SERVICES of:
1. Capable FOREMAN for large Jobbing Foundry, fully experienced in Dry and Green Sand, also Loam Work.
2. Experienced FOREMAN for Vertical Dry Sand Pipe Shops.
Only first-class men will be considered.
Apply, stating age, experience, with references, to the SECRETARY. 6124 A

BOILER PLATER WANTED, Used to Vertical, Loco. and Marine Work, able to set out own work. State age, experience, and wages required.—Address, 6112, The Engineer Office. 6112 A

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SITUATIONS WANTED

AN ELECTRICAL MECHANICAL ENGINEER (27) SEEKS APPOINTMENT as Assistant Works Manager or in other capacity. Power-house and works, experienced Diesels, steam and heavy electrical plant.—Address, P518, The Engineer Office. P518 B

CHIEF MECHANICAL ENGINEER of Ironworks and Collieries will shortly be disengaged to ACCEPT AGENCIES for well-known Engineering Firms for the Midlands.—Address, P492, The Engineer Office. P492 B

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DR. BARNARDO'S HOMES WISH to APPRENTICE LADS, 14-16, as Engineers.—Apply SITUATION DEPARTMENT, 18-26, Stepney-cause way, E. 1. P534 B

ENGINEER, A.M.I. Mech. E., 35 Years' Experience in charge of lighting and power plants, cold storage, expert electro-galvanising, excellent record.—F. WILSON, 861, High-road, Goodmayes, Essex. P532 B

ENGINEER, A.M.I. Mech. E. (43), SEEKS RESPONSIBLE POSITION. Wide experience steam power plant, auxiliary gear, steel foundry and general works engineering, industrial building construction. Several years' experience successfully controlling contract work and works maintenance on Continent. Fluent French. Shortly returning from U.S.A.
Address, P530, The Engineer Office. P530 B

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ENGINEER and MANAGER DESIRES RESPONSIBLE APPOINTMENT as Manager, Engineer, or Representative. M.I. Mech. E., keen and good organiser. Had control of a large number of men. Excellent record. Future prospects the chief consideration.—Address, P486, The Engineer Office. P486 B

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TO MANUFACTURERS Wishing to Strengthen or to Start Railway Connection.—ADVERTISER (aged 59, retired) OFFERS his ASSISTANCE. Nominal salary.—Address, P489, The Engineer Office. P489 B

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JR. DRAUGHTSMAN (24) REQUIRES PROG. POST; 10 years' D.O. and shop exp., design, detail and arrgts. for mech. and struct. eng. Good training and refs. Mod. sal.—Address, P517, The Engineer Office. P517 B

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WANTED, PARTNERSHIP (Half-share) in Small ELECTRICAL and GENERAL ENGINEERING REPAIRS BUSINESS, Nth. Midland area; if near running stream an advantage; invest £200.—Apply, T. ROPER and CO., Bromsgrove. P523 C

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ENERGETIC AGENT, Living in Cologne, with fair knowledge of English and first-class connections with German railways, tramways and municipal bodies, is DESIROUS of OBTAINING the REPRESENTATION of GOOD BRITISH HOUSES.
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THE OWNER of BRITISH PATENT No. 261,043, relating to "Improvements in or relating to Building Structures, either Underground or Wholly or Partly Under Water," is DESIROUS of ENTERING into NEGOTIATIONS for the GRANT of LICENCES thereunder on reasonable terms or to SELL the PATENT outright.—For particulars address, F. W. LE TALL, 2, Norfolk-street, Strand, London, W.C. 2. 6091 H

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The New Cunard Liners.

After a recent discussion in the House of Commons, a resolution was unanimously adopted authorising the Board of Trade to enter into an agreement with the Cunard Steamship Company, Ltd., relating to the insurance of the two large liners which are to be built for the company's trans-Atlantic service. In introducing the resolution, Mr. William Graham, the President of the Board of Trade, explained that it was difficult to cover the construction and marine insurance risks in the ordinary markets. He said that it was estimated that the first liner, which is to be laid down at the Clydebank Yard of John Brown and Co., Ltd., would cost between £4,000,000 and £4,500,000. Out of that total sum the owners expected that from £2,000,000 to £2,500,000 of the construction risk would be covered in the ordinary markets. The remainder of the risk would, Mr. Graham said, be taken over by the Government at the rate of 1½ per cent., with, in the absence of brokerage, an addition of 2½ per cent. With regard to the maritime risk of the completed liners, the Government would undertake at market rate, plus 2½ per cent., as in the case of the construction risk, such part of the risk as could not be taken by the ordinary markets. With regard to the construction of the liner on the Clyde, it was estimated, Mr. Graham said, that it would provide employment for at least 3000 men with indirect employment for 1400 to 1500 men, over a period of approximately two and a half years. The Cunard Steamship Company, in reply to a recent request that the claims of Cammell, Laird and Co., Ltd., of Birkenhead, would be considered for the construction of the second liner, has stated that while such claims will be very carefully considered, good progress will have to be made with the first ship now contemplated before the question of constructing the second ship can be taken up.

Dutch Destroyer Programme Completed.

The recent satisfactory trials of the destroyer "Van Ness" on the measured mile at Skelmorlie, which vessel was built for the Royal Netherlands Navy by Burgerhouts Shipbuilding and Engineering Company, of Rotterdam, marks the completion of a very successful destroyer-building programme. We may recall that in 1926 the Netherlands Government decided to build eight destroyers to the designs of Yarrow and Co., Ltd., of Scotstoun. The programme was carried through in two sections and of the first four ships, the "De Reuter" was built at the Royal de Schelde yards, Flushing, while Messrs. Burgerhouts constructed three ships, the "Evertsen," the "Piet Hien" and the "Kortenaer." Each of the ships is propelled by a twin-screw arrangement of Parsons turbines, steam being supplied by three Yarrow boilers working at a pressure of 275 lb. per square inch and 610 deg. Fah. steam temperature. The second half of the programme comprised the building of a further four ships, of which the "Van Galen" and the "Witte de With" were built by the Fijnoord Company, of Rotterdam, and the "Banckert" and "Van Ness" by Messrs. Burgerhouts. In these fours ships high-pressure, high-temperature turbine machinery was installed, the working boiler pressure being 400 lb. per square inch, with 685 deg. Fah. total steam temperature. The trials have shown a decided increase in economy, compared with the first four ships, which bears out the good results obtained in recent liners such as the "Viceroy of India" and in the C.P.R. "Duchess" and "Empress" liners, in which high-pressure boilers have been installed. The eight destroyers above mentioned were all built to Yarrows' design and under the firm's technical advice.

Electrical Supply Co-ordination.

On Monday, November 17th, the Electricity Commissioners held an inquiry concerning a draft order amending the London and Home Counties Electricity Order, 1925. Sir John Brooke, the Deputy Chairman, presided. Speaking on behalf of the London and Home Counties Joint Electricity Authority, Sir Lyndon Macassey, K.C., asserted that the order was supported by all local authorities in the district affected by it. That district included Twickenham, Teddington, Weybridge, Surbiton, Walton, and Kingston, and there was no opposition from anybody in that area. It was part of a much greater scheme for the co-ordination of the electricity supply from Twickenham in the north to Reigate and Dorking in the south—an area of 112 square miles. Under the order consumers would, it was claimed, be saved considerable expense. At present there were great differences in the prices charged, and one of the effects of the order would be to obtain a general uniformity of charges, and electricity would be supplied at the cheapest possible rate. In opposing the order, the London companies were making a strategic move to try and make it impossible for the London and Home Counties Joint Electricity Authority to pursue its line of policy of co-ordinating and cheapening electricity throughout the area under its control. In giving evidence, Mr. F. W. Purse, chief engineer of the London and Home Counties Joint Electricity Authority, said that in the Weybridge district electricity for lighting cost 8d. per unit, while Kingston consumers were in the fortunate position of paying from 2½d. to 5d. per unit. In Walton the price was 7½d. a unit for lighting and 1½d. a unit for heating and cooking. In Surbiton lighting cost 6d. and heating and cooking 3d. a unit. Greater efficiency with a lower cost to the consumer would be brought about by uniformity of charges, and the use of proper publicity methods to encourage the consumption of electricity for domestic purposes.

British Machine Tools for Russia.

On Tuesday of this week a general agreement was signed by Mr. S. G. Bron, Trade Representative of the U.S.S.R. in Great Britain, and Mr. Greville Maginness, chairman of the Associated British Machine Tool Makers, Ltd. The agreement provides that during the year ending October 31st, 1931, the Trade Delegation, through its agents, Arcos Ltd., shall place in Great Britain orders for different kinds of machine tools to the value of £600,000. The Association will extend to the Delegation credit to the full amount of the orders placed, and also undertakes to provide the Soviet industry with technical assistance in the construction of machine tool works in Russia. The agreement, in addition, covers an extension of trade in the future. It is intimated that the placing of orders under the agreement will be begun at once. Mr. Maginness, accompanied by other directors of the Associated British Machine Tool Makers, Ltd., is proceeding to Moscow at the beginning of next week in order to establish personal contact between the British machine tool industry and the industrial and trading organisations of the Soviet Union. Mr. Maginness' company, it may be noted, is a trading organisation representing the interests of a number of British machine tool makers, the constituent companies being such as produce, each one, a different class of machine tool. It is not, as it sometimes is, to be confused with the Machine Tool Makers' Association, a body which controls the activities of its members but does not trade.

Transport and Electricity Developments.

An official statement was received this week from the Ministry of Transport concerning the expenditure on the development of transport and electricity supply schemes authorised by the present Government with a view to stimulating employment. The total sum involved exceeds one hundred million pounds. Of that sum about half relates to schemes towards which grants are being made from the Road Fund. Towards the remainder grants are being made out of funds provided under the Development (Loan Guarantees and Grants) Act, 1929. On the improvement or reconstruction of classified roads and bridges the authorised expenditure in round figures is £50 million. An additional £6 million relates to improvements of unclassified roads. An expenditure of £10 million is authorised on improvements of docks and harbours, and over £11 million on works connected with the London Underground and Metropolitan Railways. The main line railway companies' programmes are responsible for £10 million of the total, about £1 million relates to canal improvements, and over £12 million is assigned to electricity development. These sums represent the total estimated costs of the schemes, and are not measures of the assistance given by the Government, which assistance varies according to circumstances. Of the dock and harbour improvement schemes, an important one is the carrying out of modernisation works on the Mersey at a cost of over £2 million. Other improvements are to be effected on the Clyde, Tees and Wear, at Aberdeen and elsewhere. Within the past few days the Government has approved for grants a farther extension of Southampton Docks, involving an expenditure of about £3 million by the Southern Railway, and a scheme costing about £2 million now being carried out by the Great Western Railway for the development of modern handling appliances at the docks in South Wales. The main line railway companies' schemes include widenings on the Great Western line, electrification on the L.M.S., and widenings and other works on the L.N.E.R. The greater part of the £12 million approved for expenditure on schemes of electrical development relates to the standardisation of frequency on the North-East Coast.

Certificates of Airworthiness.

It is well known that the certificates of airworthiness granted by different Governments to aircraft of their nationals are far from possessing uniformity of value. We in this country have, for example, been led, no doubt correctly, to esteem a British certificate at a considerably higher value than the certificates of some continental nations. According to the Air Convention, all aircraft engaged in international aviation must be provided with certificates of airworthiness. The different countries accept each other's certificates, but in actual fact there is no minimum of requirements common to them all, with the result that the foreign certificates accepted in this country may permit an aeroplane to carry passengers when its construction or condition is such that it would not be given a British certificate. It was suggested last March, at a meeting of the International Commission for Air Navigation, that the position should be considered afresh. As an outcome an international technical committee, consisting of representatives of Belgium, France, Italy, Holland, Czechoslovakia and Great Britain, met on Tuesday last at the Air Ministry for the purpose of drawing up regulations for the minimum requirements of airworthiness in aeroplanes. The British view is that in the past there has been too much concentration on details in drawing up the regulations. It is argued that the regulations should be drawn up in general terms covering all aspects of flying, and that each country should be left free to deposit the details of its own rules with the International Commission and with every other individual country with which it desires to establish a service.

The British Electrical and Allied Manufacturers Association.

At the annual dinner of the British Electrical and Allied Manufacturers' Association, held at the Connaught Rooms on Wednesday, November 19th, Sir Hugo Hirst, in proposing the toast of "The Electrical Industry and Industrial Co-operation within the Empire," called attention to the fact that the electrical industry was seriously menaced by the importation of foreign goods. When the Central Electricity Board was created with the object of establishing and superintending the "grid" scheme, everyone thought that the cheapening of electricity would result in improved conditions in factories devoted to the production of domestic and other electrical appliances; but, unfortunately, the foreign producer was beginning to enjoy the principal benefit of the "grid" scheme. Protection of labour was impossible unless it was accompanied by the protection of the products of labour. So far as the electrical industry was concerned, safeguarding would not mean increased prices, but a reduction in prices.

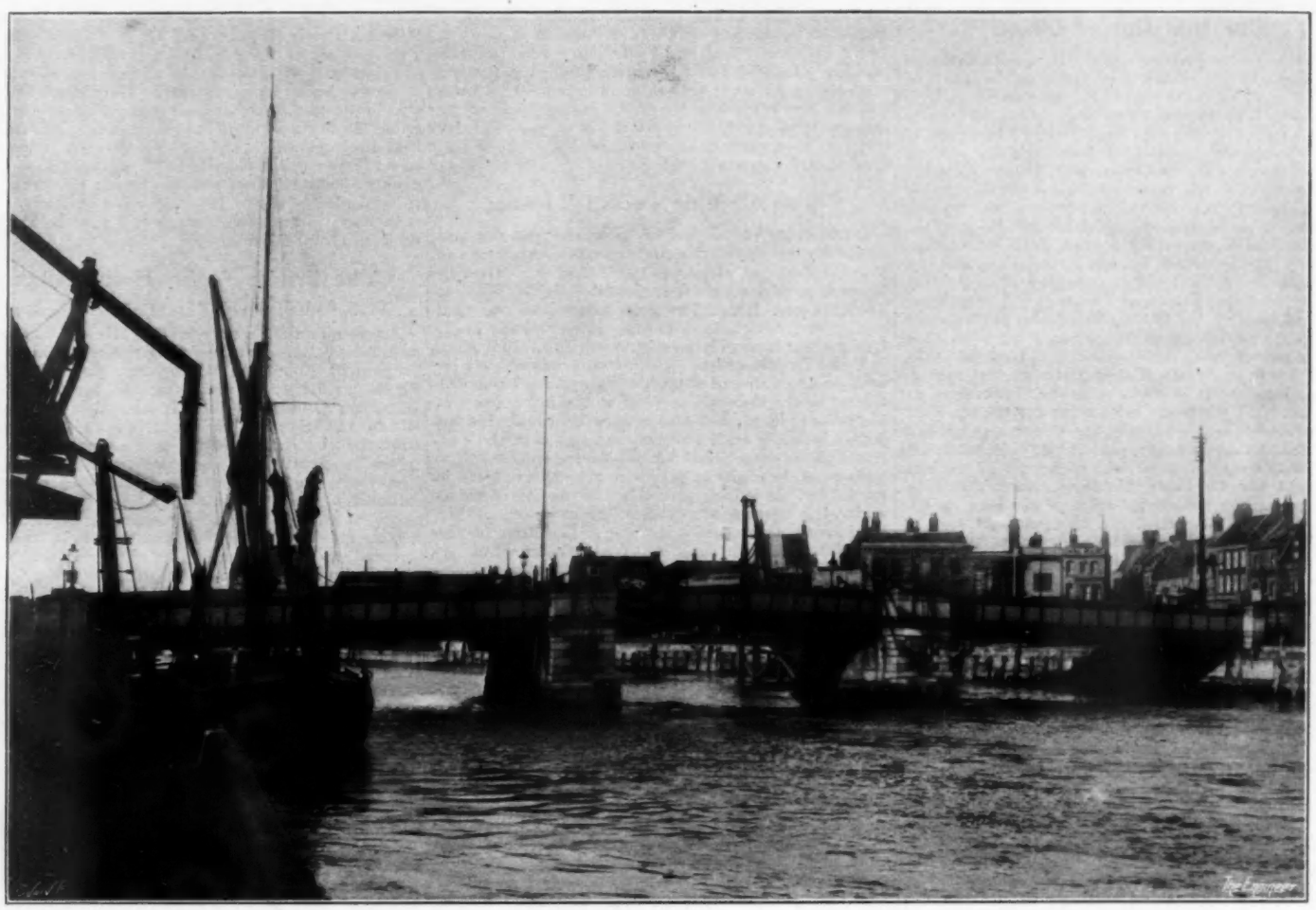
Railway Wages.

Last week the railway managers proposed reductions in the wages of the men in the traffic and clerical grades of the service, the annual value of which would, it is officially estimated, amount to £9,500,000. The principal items in the managers' proposals were a reduction of 6s. per week in the wages of the adult male staff and a reduction of £10 to £15 per annum in the case of the male salaried staff. On Monday last the managers met representatives of the railway shopmen and made proposals for reductions estimated to amount to £1,500,000 per year. The principal item in the proposals in this case was the reduction of the war wage of 16s. 6d. per week by 6s. 6d. for men employed on piecework and 4s. 6d. for men on time work. These reductions, it was pointed out, would bring the war wage to 10s. and 12s. per week respectively, the present values of the war wage in the general engineering industry. Under the two headings the managers' proposals are estimated to effect a saving of £11,000,000 a year, or roughly 10 per cent. of the total wages and salaries bill. The unions are opposing the proposals, and are, in fact, advancing counter proposals for increased remuneration and altered terms of service, which, if granted, would involve the companies in several million pounds of increased expenditure in the course of a year. The proposals of the companies have been described as absurd by Mr. C. T. Cramp, of the N.U.R., and as making a battle inevitable by Mr. J. Bromley, of the Engineers' and Firemen's Union.

The Association of Scientific Societies.

On Thursday of last week a company of over 500 guests assembled for dinner at Guildhall at the invitation of the Association of Scientific and Technical Institutions. The dinner was honoured by the presence of H.R.H. the Prince of Wales. Sir Ernest Rutherford, President of the Royal Society, was in the chair. The full title of the association is "The Association for the Promotion of Co-operation between Scientific and Technical Societies and Institutions within the British Empire." It may be said to have grown out of the establishment eight years ago of the Empire Council of Mining and Metallurgical Institutions. In addition to certain overseas institutions, the Association numbers among its constituents the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Institution of Petroleum Technologists, the Iron and Steel Institute, the Institute of Metals, the Institute of Fuel, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, and the Institution of the Rubber Industry. Joined to it as associated bodies are the Association of British Chemical Manufacturers, the Mining Association of Great Britain, and the National Federation of Iron and Steel Manufacturers. It is among the aims of the Association to provide a common home in London for the headquarters and meetings of the constituent bodies. At last week's dinner Sir William J. Larke announced that a gift of £10,000 had been received by the Association from Mr. Robert Mond as a contribution towards the cost of setting up and equipping the central building. The offices of the Association are at Burlington House, Piccadilly, W. 1.

THE OLD IRON BRIDGE AT GREAT YARMOUTH



New Bascule Bridge at Great Yarmouth.

THERE have been several bridges across the harbour at Great Yarmouth, all erected on or close to the site of the bridge described in this article. The earliest records show that a timber bridge of eight spans was erected in 1417. This was converted into a drawbridge in 1553, which was seriously damaged by storms in 1557 and again in 1570, but was repaired on both occasions. Another bridge, with levers for operating the opening span, was erected in 1785; these levers were displaced by wheels in 1809. This bridge existed until 1835, when the Port and Haven Commissioners erected a temporary bridge. In 1843, an iron bridge was commenced, but the contractor became insolvent, which involved the Commissioners in litigation, and in 1845 a Royal Commission, reporting on the harbours of Great Britain, condemned the proposed iron bridge and recommended the construction of a bridge with a 50ft. clear opening span. Powers were obtained to carry out the above recommendation, and the iron bridge, with masonry piers and abutments, shown above, was constructed at a cost of about £60,000. This had two fixed side spans, each of 65ft., and an opening span of 50ft., consisting of two bascule leaves operated by hand, a roadway 16ft. in width, and two narrow footpaths, each 3ft. 9in. in width. The engineers for this work were Messrs. Walker and Burgess, and their bridge was opened in 1854 and existed until February, 1928, when it was demolished to make way for the new bridge recently erected on its site.

It became obvious, even before the war, that a wider bridge, with a larger opening span, was required to deal with modern vehicular traffic and the vessels of increased size that used the port, and proposals were put forward by the Haven Commissioners for the construction of a new bridge, but on account of opposition due to anticipation of an increase in the local rates, these were not carried into effect.

FIG. 1—THE TEMPORARY LIFTING-SPAN BRIDGE

In 1925, the Port and Haven Commissioners, in conjunction with the Corporation of Great Yarmouth, obtained parliamentary powers to demolish the existing bridge and to construct a new one on the same site, and at the same time to erect a temporary bridge to deal with the traffic during the carrying out of the work. The temporary bridge was absolutely essential, as there is no other means of crossing the Yare nearer than Norwich, some 20 miles away.

As will be seen from Fig. 4 and from the photographic views reproduced on page 570, the new bridge consists of two shore spans of 44ft. each, and an opening span of 90ft., and in order to preserve the width of the waterway of the river, which drains the Norfolk Broads, the new abutments were set back in rear of the abutments of the old bridge, in order to compensate for the water area occupied by the two large masonry piers carrying the heels and gearing of the two opening leaves of the new bridge.

The programme for carrying out the works was arranged so that there should be no interference with the road and river traffic, and it was also essential that the area of the waterway of the river should not be blocked more than was absolutely necessary, and for these reasons the execution of the works has occupied a considerably longer time than would otherwise have been necessary.

A contract was signed in September, 1926, and preliminary work was commenced towards the end of that year, some delay having occurred on account of the general strike. The new quay walls on the north side of the bridge on the site of the temporary bridge were first put in hand, then the temporary bridge was erected and opened for traffic in February, 1928, when a commencement could be made with the dismantling of the old permanent bridge. The new west abutment was then constructed and the old west abutment was demolished, after which the caisson of the new west pier was sunk in position and the old west pier was taken down. In the meantime, the new east abutment was put in hand and the old east abutment demolished, after which it was possible to proceed with the sinking of the new east pier and demolition of the old east pier. The old piers were of great use as a protection to the new work during construction from damage by passing vessels.

The temporary bridge, shown in Fig. 1, has an opening span of 70ft. 6in., with a clear waterway of 62ft., supported on timber piling, with a timber roadway 16ft. 6in. in width, and two footpaths, each 6ft. 6in. wide. It was operated electrically, and the counterweight travelled on a curved path which gradually flattened out towards its lower end, which lessened the pull of the counterpoise as the weight of the lifting span was reduced on account of the latter assuming a more upright position as it was raised. It was designed to take two lines of traffic with axle loads of 12 tons, and was in use just over 2½ years—from February, 1928, to October, 1930—during which period it was opened about 2242 times without any failure. The approximate time of passing a vessel through this bridge was about 6½ to 7½ minutes, from closing the roadway to opening it again to traffic.

The permanent bridge is 230ft. between abutments, with a central span for navigation of 90ft. in width. The roadway is 42ft. wide between kerbs, and there are two footways, each 10ft. in width. It was originally intended that the Corporation tramways should be carried across the bridge, but as these are now gradually being done away with, the tramway tracks were ordered to be omitted after the works were started. This accounts for the unusually wide roadway, but in view of the exceptionally heavy traffic across the bridge, it is a fault in the right direction. The new bridge has been designed to take four lines of the Ministry of Transport's standard loading.

The leaves of the opening span are of the rolling Schertzer type, operated by electrical machinery, which is housed immediately over the rolling heels and controlled from the operator's cabin on the west side. Provision is made for operating by hand should any failure in the electric current occur. Each opening leaf weighs about 302 tons, and with the counterweight ballast of 233 tons constitutes a moving weight of 535 tons. They each consist of three main mild steel plate arched girders with cross girders and longitudinal stringers; the footways are supported by heavy cantilever brackets and longitudinal stringers. The roadway is formed of mild steel flat plates, to which is bolted creosoted transverse pitch pine planking, on top of which is creosoted "Acme" dowelled wood block paving secured to the transverse planking by galvanised coach screws. The footways are creosoted pitch pine planking. At the heels of the opening leaves are the machinery chambers and the tanks for carrying the counterweights. The tracks for the rolling heels are of nickel chrome cast steel and the quadrant tires are nickel chrome rolled steel, each 3in. in thickness.

Each approach span has five mild steel plate girders with cross girders and longitudinal mild steel trough decking filled with concrete in mass carrying creosoted wood block paving. The footways are supported on cantilever brackets and consist of longitudinal trough decking filled with concrete in mass, on which is laid "non-slip" paving with granite kerbs.

The caissons of the main piers in the river were each 100ft. long, 28ft. wide, and 32ft. deep, and had a working chamber 8ft. in height, with two shafts for access and the passage of materials—see Figs. 2 and 3. The lower portions were erected above water on a staging and gradually lowered by four 120-ton hydraulic jacks till they were afloat, when the upper strakes and some of the internal concrete in mass filling was added until the cutting edges rested on the bed of the river, which had been levelled to receive them. They were sunk under compressed air, great care being necessary to ensure that they were in the correct position and sunk to the correct level. The foundations throughout were compact gravel and sand, which is of such a good character that no settlement in the piers or abutments has been observed.

The abutments are 80ft. long, 18ft. wide, and 21ft. deep, and were constructed inside mild steel sheet pile cofferdams, which were kept dry by pumping.

The superstructures of the piers and abutments are faced with Cornish granite backed with concrete in mass, and the masonry of the two operating cabins is Aberdeen granite.

The electric cables for operating the bridge are carried beneath the bed of the river between the piers by means of a subway 5ft. 10in. exterior diameter, which was driven by means of a shield and compressed air. This subway is formed of cast iron segments ¾in. in thickness, and is lined with concrete in mass, access thereto being obtained by means of a vertical shaft in each pier. In addition to the operating cables, provision has been made in the subway for Post Office telephone mains and cables for the Corporation Electric Supply Department.

The time occupied in opening the navigation span is one minute, and to close the same takes two minutes.

Almost the whole of the operating mechanism is built into the moving leaves, power being carried to the driving motors through flexible cables. In view of the fact that it was of great importance that the new bridge should be capable of being rapidly opened and closed, it was decided to adopt automatic motor control switchgear. Each moving leaf contains its own driving motors and power is supplied from the 346-volt, 50-cycle, three-phase, four-wire mains of the Yarmouth Corporation. There are power mains on both east and west sides of the river, and the bridge circuits are arranged so that the control system and the motors for both leaves are normally fed from the supply on the west side of the river. In order to guard against stoppage of the bridge through an interruption of the supply on the west side, the bridge control system and motor supply can be changed over to the east side power mains by means of a simple change-over switch, and a connecting power cable, which is laid together with the control cables in the subway under the river.

FIG. 2—WEST PIER CAISSON—WORKING CHAMBER

FIG. 3—EAST PIER UNDER CONSTRUCTION—LOOKING DOWNSTREAM

FIG. 4—THE NEW AND TEMPORARY BRIDGES

There are two control houses, one on the east and one on the west side of the bridge—see Figs. 5 and 6. The bridge is operated from the west side house, and that building contains a drum type master switch together with a visual indicator and master push button. The east side cabin contains the automatic switchboards for controlling all the functions of the leaf on that side, but it is operated from the west side cabin by control cables which pass in the subway under the river. The driving motors, auxiliary motors, brakes and safety switches that operate each leaf constitute an interesting combination of interlocked devices for ensuring the safe and reliable operation of the bridge.

Although the opening and closing of the leaves is under the primary control of the operator in the west side cabin, the automatic switchboard and various auxiliary switches connected thereto are so arranged that the various operations in opening and closing must follow each other in correct sequence. Each leaf is equipped with two 35 H.P. main motors of slip-ring reversing type, which are arranged to come into operation independently or simultaneously if the load conditions should require greater power. The west side leaf has also two 5 H.P. non-reversing squirrel-cage auxiliary motors for the purpose of bringing the bridge into the finally closed position at low speed. Either or both motors will be used as occasion requires. Both moving leaves are locked in the closed position by means of pawl gear, there being one 2 H.P. squirrel-cage reversing motor to each leaf for that purpose.

Electrically-operated brakes are used throughout, there being two three-phase brakes on each leaf, one for retarding the motion and the other for holding the leaf in any position. On the west leaf, which accomplishes the final closing, there is a further auxiliary brake, and each pawl motor has also a magnetic brake. These pawl motors are also each fitted with two limit switches, which automatically stop the motor at either limit of travel.

The leaves of the bridge are provided with a total of six limit switches which are automatically operated as the bridge comes into its various positions. These switches are interconnected with the circuits of the various motors so as to interlock their respective operations and also provide the means for actuating the signals on a luminous indicator. The master controller, by which the operator in charge handles the bridge, is of the drum type. It does not carry the main circuits of any of the motors, but serves only to actuate the various magnetic contactors on the automatic switchboards. It is on the two switchboards that all the operations of the different motors and switches are interconnected and co-ordinated, so that all movements must be carried out in their proper order. The switchboards also carry the fuses and overload relays for the protection of each motor against short circuits from overloads, and the control circuits are so arranged that an overload occurring on any one motor trips the main supply contactor and arrests the whole operation of the bridge, and the fault must be corrected before the bridge can be further power-operated. Should one leaf, therefore, stop through an overload or for any other reason, the other one will also stop, and the movement of the leaves can be stopped and reversed at any point. When stopped, they are held in any position by the magnetic brakes. When the main contactor has been opened in consequence of the occurrence of an overload, the bridge cannot again be power-operated until the man in charge has returned the master drum controller to the "off" position.

The control board provides for the automatic starting and stopping of a total of eight motors. For the four 35 H.P. slip-ring motors for the main drive, there are provided in each case interlocked reversing contactors for the stator circuit and three contactors for cutting out the steps of resistance in the rotor circuit, together with an automatic timing relay to regulate the rate of acceleration. The 5 H.P. auxiliary motors on the west leaf, being squirrel cage type, are thrown across the line by magnetically operated contactors, and a timing relay is provided so that the auxiliary motor or motors are maintained stalled when the bridge is closed, until the brakes are definitely applied. The 2 H.P. pawl motors are each controlled by interlocked reversing contactors to throw the motors across the line in the required direction. The switchboard is also furnished with isolating switches for each motor circuit and the necessary fuses, time-lag overload relays, brake relays and ampère and volt meters. The drum type master controller is arranged so that successive movements of the lever in the required direction carry out the following sequence of operations:—Each step is signalled as it occurs, the visual indicator being arranged with two vertical columns, under the headings "West Leaf" and "East Leaf," with parallel compartments which are successively lit up to give the required signal.

In opening the bridge the master controller is moved to notch 1, and the holding brakes are released on both leaves. On moving to notch 2, both the 2 H.P. pawl motors are started up. The locking pawls are withdrawn from both leaves and the motors are stopped at the limits of travel by the pawl limit switches. The indicator then shows "Pawls out" for both east and west leaves. On moving to notch 3, both retarding brakes are released, and the main motors started up in both leaves, so that the bridge begins to open. The indicator then signals "Opening" for both leaves. When the leaves approach the fully raised position they throw over limit switches, which actuate the automatic control panel, so as to cut off power from the main motors and apply retarding brakes so that each leaf is stopped, independently, in the fully open position. The indicator then shows "Open" for each leaf. The operator finally returns the controller to the "Off" position, which applies the holding brakes.

In closing the bridge, moving the master lever to the first notch, releases the holding brakes on both leaves. Proceeding to notch 2, both retarding brakes are released and the main motors started up on each leaf to close the bridge. The indicator then reads "High speed closing" for both leaves. As the leaves approach the nearly closed position, another set of limit switches comes into play, so that power is automatically cut off from the driving motors and the retarding brakes are applied. The bridge comes temporarily to a stop and the indicator shows "Change over" for both leaves. The timing relay on the west leaf automatic control panel provides a delay of about 3 seconds, after which the auxiliary brake on the west leaf is released and the 5 H.P. auxiliary motors are started up. The indicator then shows, for the west leaf only, "Low speed closing."

It is then necessary to release the retarding brake on the east leaf, and that is automatically done by means of a further limit switch fitted on the nose of the west leaf, which is tripped when the shear locks of the two leaves engage at the centre of the bridge. From that point the two leaves are driven down together by the auxiliary motors operating in the west leaf. The indicator then reads "Low speed closing" for the east leaf only. When the two leaves have been driven right home, power is automatically maintained for a few seconds on the auxiliary motors, so that they are held stalled before cutting off power and applying the auxiliary and retarding brakes. The indicator then shows that both leaves are "Closed."

Notch 3 starts up both the 2 H.P. motors, so that the locking pawls are driven under both leaves, the motors being stopped automatically by limit switches at the end of the travel. The indicator then reads "Pawls in" for both leaves. Finally, the control lever is returned to the "Off" position, and that operation applies the holding brakes. The master drum is so arranged that, should the lever be fully thrown over in either direction, the sequence of operations will be automatically carried out in proper order and time by the interlocking and timing device on the control panels.

The master push button is of the two-way type. When the button marked "Start" is pressed, the main supply contactor closes. When the button marked "Stop" is pressed the main contactor opens and cuts off the supply. Thus when the "Stop" button is in the closed position, movement of the master drum controller will not operate the bridge.

The control gear was designed and manufactured by the Igranic Electric Company, Ltd.

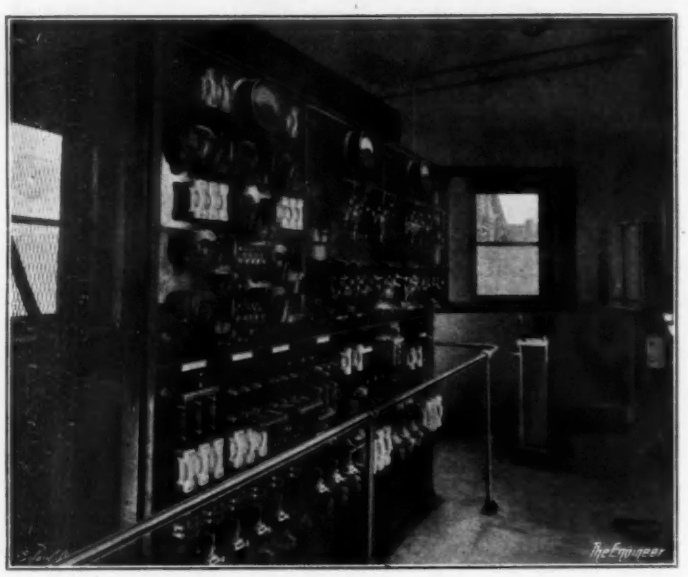


FIG. 5—INTERIOR OF WEST CONTROL HOUSE

FIG. 6—INTERIOR OF EAST CONTROL HOUSE

The cost of the bridge, including parliamentary and other expenses, is about £200,000, towards which the Ministry of Transport has given a grant of two-thirds the total cost. The permanent bridge and the temporary bridge were designed by Messrs. Coode, Wilson, Mitchell, and Vaughan-Lee, with whom were associated Messrs. Mott, Hay and Anderson. Messrs. Preece, Cardew and Rider advised the engineers with regard to the electrical equipment. Mr. George Hobbs, M. Inst. C.E., acted as resident engineer. Sir William Arrol and Co., Ltd., of Glasgow, were the contractors, being represented at the site by Mr H. P. Forge, as agent in charge.

Side Wind and the Resistance of Trains.

By C. F. DENDY MARSHALL, M.I. Loco. E.

WHEN a strong wind is blowing across the track, it is well known by experience that the resistance of a train is greatly increased; but the almost complete neglect of the study of the aerodynamical conditions in which a train operates has allowed, for years, a quite wrong explanation of the effect to be accepted. This explanation, based neither on experimental observations nor theoretical calculations, but being merely a guess, and a bad one at that, was that the pressure of the wind tends to drive the whole train over against one rail, increasing materially the flange friction against this rail. (Incidentally, it is never noticed that in such conditions the flange friction on the other rail would be relieved.)

The writer was under the impression that he had completely exploded this theory in Chapter XII. of his book "The Resistance of Express Trains." It was, therefore, very disappointing to find it cropping up again in a paper recently read by a great authority before the British Association, and, unfortunately, picked out for special prominence in the report of the paper in *The Times*.

From the book referred to it may be gathered that the normal flange resistance of a bogie carriage at 40 miles an hour is of the order of 5 lb. per ton. It is, of course, rather a difficult matter to form an estimate of the possible amount by which this resistance might be increased by wind pressure on the side, but calculations, which were intended to produce the maximum figure to which it could rise under the most unfavourable conditions possible, gave a result of 2¼ lb. per ton. Even this amount would not be all added to the normal total, on account of the relief,

to which reference has already been made, in the friction on the weather side.

It is not necessary to go into the above calculations again, as a short consideration of the wind conditions will show that air resistance alone is ample—in fact it looks far more than ample—to account for the result.

Let us suppose a storm of 70 miles an hour is blowing at right angles to the rails. It will, of course, be agreed that what we have to take into account is not the "natural wind," but the resultant of the velocity of the wind and the train, or what is known in aeronautics as the "relative wind."

The formula in "The Resistance of Express Trains" for the magnitude of the resultant, which is a matter of simple trigonometry, is :

$$X = V\sqrt{u^2 + 2u\cos\alpha + 1}$$

where X is the resultant ; V, the speed of the train ; u, the ratio of wind speed to train speed, and α, angle of wind. Suppose the train is travelling at 40 miles an hour, then $u = 1{\cdot}75$, and the value of X is approximately 80 miles an hour.

The angle of the relative wind is given by—

$$\tan\theta = \frac{u\sin\alpha}{u\cos\alpha + 1} = u = 1{\cdot}75\ ;\ \text{whence}\ \theta = 60\tfrac{1}{4}\ \text{deg.}$$

If the train was travelling at 80 miles an hour in a calm, and its cross section was 100 square feet, the amount of air displaced by its actual volume would be 11,700 cubic feet per second, which is about 944 lb. But by going at 40 miles an hour with a 70 mile wind at right angles, we are doing what is equivalent to pushing the train through still air, 80 miles an hour, at an angle of 60 deg. to its centre line.

The virtual area, if it is 500ft. long and, say, 9ft. high, is 4500 sin 60 deg. = 3897 square feet ; and the amount of air actually encountered is $3897 \times 117 = 455{,}949$ cubic feet per second, or 36,808 lb., which is over 16 tons. Need one say more ?

It has recently come to the writer's knowledge that one great engineer of the past, at least, knew better than to subscribe to the flange-resistance theory. In May, 1845, Brunel—the younger—was giving evidence before a Select Committee on the "Northumberland Railway," which was being proposed, on the atmospheric system. Counsel said to him, "With regard to the resistance from the atmospheric line the greatest resistance, I apprehend, is caused by a side wind making the wheels bind against the rails ; is not that the case ? "

The reply was : "I think from observations I have made the principal resistance from side winds arises from the circumstance that with a side wind the air that surrounds a train is constantly putting in motion fresh particles of air, whereas in still weather the train is carrying with it a large body of air, not putting in motion fresh quantities."

The question of the envelope of air round a moving train, to which he refers, which does not exist when there is a strong side wind, has not been entered upon, because it would have introduced much complication, and the simple calculations which have been made are ample to prove that a tremendous amount of air resistance must arise in the conditions laid down.

Should anyone be still inclined to cling to the old explanation, let him produce an instance of an exposed piece of line, where the prevailing winds are across in one direction, and show that the rails on one side require renewing oftener than on the other.

Wireless Developments in Canada.

(From a Canadian Correspondent.)

CANADA'S first adventure into wireless communication took place twenty-nine years ago, when in 1901, the late D. H. Keeley, a member of the Engineering Institute of Canada and Superintendent of the Government Telegraphs, entered into a contract with Mr. Marconi to establish two stations in the Belle Isle Straits, one at Chateau Bay at the terminus of the land line on the main land, and the other on Belle Isle, 30 miles distant, to replace the submarine cable, which was continually going out of commission on account of icebergs.

Mr. Marconi has recently recalled the fact that the first Transatlantic signals were received at St. John's, Newfoundland, by means of an aerial supported by a kite on December 12th, 1901, and Sir Wilfred Laurier, the Canadian Prime Minister, then in power, quick to appreciate the possibilities of wireless transmission, invited the young inventor to proceed to Canada, with the result that a contract was entered into for the establishment of a Transatlantic wireless service between Canada and Great Britain, the Canadian Government to pay a subsidy of 80,000 dollars towards the Canadian stations. Glace Bay, Nova Scotia, was selected as the site, and in 1902 the first messages were exchanged between the Earl of Minto, then Governor-General of Canada, and his Majesty, King Edward VII. After a somewhat prolonged experimental period, the first commercial Transatlantic service was initiated between the station at Glace Bay and another at Clifden, Ireland, in October, 1907.

Concurrently with the contract for the establishment of the first Glace Bay Transatlantic station, contracts were entered into for the building of a chain of twenty coast stations along the river and Gulf of St. Lawrence, to the Belle Isle Straits, and from St. John and Halifax to Cape Race along the east coast. These stations were of comparatively low power, and were installed in 1903, 1904, and 1905, and it is tribute to the quality of the apparatus that at some of these stations in the more isolated points, where they do not cause interference, the major part of the original plant is still in operation.

In 1907 work was started on a chain of nine stations to provide communication along the coast of British Columbia, including the Queen Charlotte Islands, and in 1912 a third chain of eight stations was established from Port Arthur to cover the Great Lakes, incidentally linking up with the east coast chain at Montreal. At all these stations constant watch was maintained, day and night, and, from the time a ship was 250 miles from Canadian shores, she was in constant touch with one or other of the stations until she reached her final port.

The original stations all contained much the same plant—see Fig. 1. The prime mover was a 4 H.P.

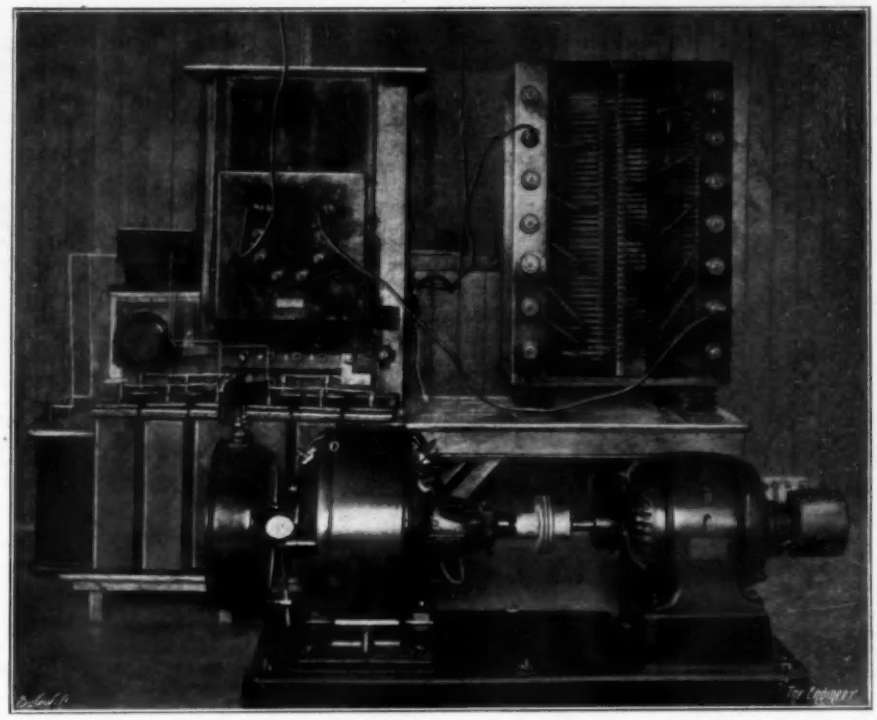


FIG. 1—ORIGINAL SPARK TRANSMITTING APPARATUS USED ON THE GREAT LAKES

engine and the transmitter was of the spark type rated at 2 kW. At first coherers, and shortly afterwards magnetic detectors—the latter due to the research work of Dr. Rutherford, of McGill University—were used for reception, and the working range of this combination was some 250 miles. As the art progressed, higher-powered and more efficient sets, using the same type of transmitter but of 5 kW rating, replaced the original equipments, and, with the more sensitive crystal type of detector, the range of the stations was materially improved. Nevertheless, the general design remained fundamentally unchanged except in minor details, until the year 1918, when transmitters employing valves began to be universally adopted.

The large investment in Canada and throughout the world in ship-to-shore spark equipments, delayed the early adoption of the valve type of transmitter, but, so far as Canada is concerned, the advent of broadcasting rendered such a change urgently desirable in the interest of broadcast listeners, and the Canadian Marconi Company having developed a valve transmitter suitable for coast station operation, the Government embarked on a programme of replacing all spark sets in its stations, beginning with those in the more populous centres, such as Toronto, Montreal, Vancouver, &c., with the result that, to-day, except in one or two isolated points, all Canadian stations are operating on continuous wave.

This transmitter is rated at 1600 watts output and has a frequency range of 500 to 100 kilocycles. For convenience in handling, it is divided into five units, viz., rectifier, oscillator, closed circuit inductance, closed circuit condenser, and aerial tuning inductance. The components of each unit are mounted on angle iron frames, which are covered with wire mesh screens to prevent accidental contact with high-voltage conductors. All high-voltage parts are insulated with porcelain. Power is supplied to the set at a pressure of 220 volts 60 cycles. The pressure is stepped up and double-wave rectification is carried out by two rectifier tubes. The resultant direct current at 10,000 volts, after being passed through a filter, is fed to the anodes of two oscillator valves operating in parallel in a Hartley circuit. Small transformers of suitable ratio, supply current for heating the filaments of the oscillator and rectifier valves. The condenser in the closed circuit is insulated with porcelain and uses air as the dielectric in order to avoid possible trouble which might result from failure of a solid dielectric such as mica. The aerial tuning inductance is coupled to the closed circuit by means of an aperiodic link, and both the closed and aerial tuning units are equipped with selector switches for quickly changing to any one of four predetermined waves. Interrupted continuous wave transmission is obtained by means of a motor-driven tonic train wheel and the set is also equipped with a small low-voltage motor-generator for supplying direct current to operate the keying relay and the magnetic send-receive switch.

The transmitter sets for ships standardised in Canada are the 500-watt continuous wave and interrupted continuous wave transmitter and the 100-watt continuous wave, interrupted continuous wave, and telephone transmitter, short descriptions of which follow :—

The 500-watt ship equipment is a one-unit set delivering 500 watts of high-frequency energy to the antenna. It consists—see Fig. 2—of a rigid angle iron frame upon which are assembled the component parts of the oscillatory and control circuits. Continuous wave and tonic train communication are provided over the wave range of the transmitter, and either method of signalling is available by throwing the signal switch mounted on the transmitter panel.

In laying out the transmitter, attention has been paid to the special requirements of ship use. The overall size of the unit is such that it will pass through the ordinary ship's cabin door. All vital parts are clear of the floor.

The transmitter has a wave range of from 600 m. to 2400 m., when used with an aerial having a natural wave length of 250 m., and a capacity of 0·0007 microfarad. Any one of four wave lengths in this range may be selected by a single operation switch. The transmitter is normally wired to permit of two wave lengths in the bands from 600 m. to 1300 m. and two in the band from 1200 m. to 2400 m.

A 2000-volt direct-current generator, rated at 1500 watts output and direct connected to a 110-volt direct-current motor, supplies the high-tension power for the osillator valves. This machine is provided with an automatic starter controlled by a push-button switch arranged in any convenient position. Provision is also made for opening the generator field circuit when receiving.

A low-voltage generator, driven by a 110-volt direct-current motor, supplies the heating current for the valve filaments. The power supply for both motors is drawn from the 110-volt ship's mains. The two machines are independent of the transmitter, and may be placed where convenient. The insulation of the transmitter has been given careful consideration, and is designed for high safety factor as regards creepage and flash over.

The 100-watt transmitter provides three classes of transmission, namely, radiotelephony, continuous wave and interrupted continuous wave telegraphy. It is capable of delivering 100 watts to the antenna when used for telephony or interrupted continuous wave, and 150 watts when used for continuous wave signalling.

The apparatus is strongly constructed and is simple to install and operate. Protection to both operator and apparatus is afforded by the necessary screening, fuses, by-pass condensers, &c. The complete equipment consists of transmitter unit, high and low-tension motor generator unit and associated control rheostat, power control switches, signalling key and microphone equipment. The power equipment consists of a motor driving a double-current generator supplying 1000

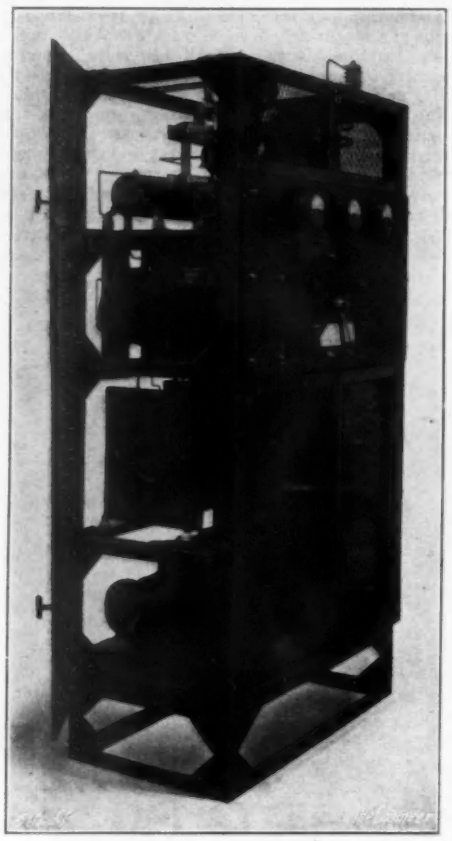


FIG 2—500-WATT SHIP EQUIPMENT

volts direct current to the valve anodes and 12 volts 12 ampères for the valve filaments and auxiliary equipment, such as the tone wheel motor and the high-tension magnetic switch energising coil. Switches are provided for the line voltage, and a control rheostat for the regulation of the generator field current.

The wave-length range of the transmitter is between 200 m. and 800 m., depending on the aerial dimensions.

FIG. 3—INTERIOR OF DIRECTION-FINDING STATION AT ST. JOHN, N.B.

A wave-change switch, which permits the quick selection of any one of three fixed wave lengths within the wave length band, is provided.

The oscillatory circuit is of the Hartley type excited by one U V–211 Radiatron modulated by a second U V–211 in the so-called constant current circuit. The microphone circuit is transformer-coupled to the modulator valve. For continuous wave communication, both valves are used as oscillators, a switching arrangement enabling that to be done. Tonic train transmission is obtained by connecting a small motor and tone wheel with signalling key to the modulation transformer in place of the microphone. Before being fed to the speech choke, the high-tension supply passes through a filter which effectively suppresses the generator commutator ripple.

An interesting development introduced by the Marine Department on the Pacific Coast, in 1924, is a wireless telephone service to and from tug boats and other small vessels plying on the coast. Wireless telephone stations have been established at Vancouver, Merry Island, Cape Lazo, Alert Bay and Digby Island, and the service has proved of great value to tug owners, some forty-nine tugs being now equipped. It is purely a point-to-point service, and has not as yet been extended to the regular land telephone lines.

The chains of stations established by the Government on the East Coast, Hudson Straits, &c., whilst established primarily for ship-to-shore communication, serve a second useful purpose in providing facilities for communication with small stations erected at isolated points by private enterprise. On the Pacific Coast, for instance, service is given to some 36 local stations in canneries, pulp mills, &c., which have no access, and, on account of the rugged nature of the country, are not likely to have access to landline facilities for many years to come.

An example recently brought to the public eye was the story of the MacAlpine Expedition, which was handled through a small station established by the Dominion Explorers at Bathurst Inlet, communicating with the outside world through the Port Churchill station of the Hudson Bay chain. Similar communication facilities are available to isolated communities in the interior of Canada through the medium of the wireless stations operated by the Royal Canadian Corps of Signals along the Mackenzie river in the North-West Territories and at several other points across Canada at which that service maintains stations in connection with civil aviation activities.

Point-to-point communication is also extensively used by public utilities and power companies, for emergency in communication between their power plants and distribution centres in case of interruption of the normal telegraph or telephone communication, and an interesting experiment is being undertaken by the British Columbia Telephone Company at Powell River, on the Pacific Coast, relying on wireless links in the establishment of regular telephone service to isolated points.

WIRELESS DIRECTION FINDING.

The wireless radio direction-finding stations in Canada were, originally, four in number. They were established on the East Coast in 1917 for war purposes. At the close of the war it was decided to continue them as an experimental aid to navigation. They were so successful that additional stations were established at Saint John, N.B.—see Fig. 3—Saint Paul Island, Nova Scotia, Belle Isle, on the East Coast, and Pachena on the Pacific Coast. The Canadian direction-finding stations give approximately 38,000 bearings per annum, and while they are not intended to supersede existing instruments of navigation, they act as accurate check. Fixes are obtained by intersection of the bearings from two or more stations, or a ship can navigate on a line of bearing, as, for example, on approaching Saint John up the Bay of Fundy.

Canada's latest application of direction finding as an aid to navigation is in Hudson Straits and Hudson Bay, where wireless communication may be said to have truly come into its own. Four stations of the latest type are now in operation at Resolution Island—see Fig. 4—Hopes Advance, Nottingham Island and Churchill, and they have been fully utilised by the ships plying in those waters. The stations are manned the year round and provide a useful service in their weather observations, which are of great value to the Meteorological Division of the Department of Marine, in making up the daily weather forecasts. Communication with the outside world is maintained by a short wave link from Hopes Advance to Ottawa, the federal Capital, by long-wave communication between Resolution Island and Father

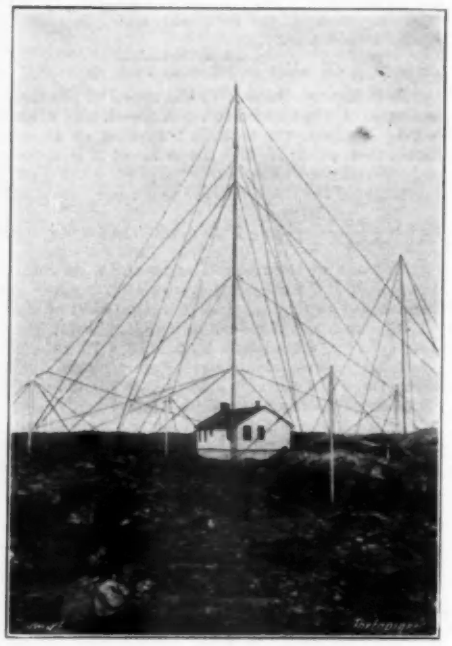


FIG. 4—DIRECTION-FINDING STATION ON RESOLUTION ISLAND

Point, in the province of Quebec or Belle Isle on the St. Lawrence system, and also *vid* Port Churchill and the Canadian National landline.

WIRELESS BEACONS.

The first series of Canadian wireless beacons, which, in effect, play the part of lighthouses, were installed at Cape Bauld, Belle Isle Straits; Cape Ray, Cabot Straits; Seal Island, Nova Scotia, and on lightships stationed off Heath Point (Anticosti), Sambro and Lurcher shoals. They consisted of converted sets of the spark type and obtained their power supply from the prime mover of the fog alarm, being worked during fog only. They were operated through a period of useful experiment, and, sufficient data and experience having been secured to form reasonable conclusions, the Marine Department, two years ago, embarked on a regular scheme of installation of an automatic valve type of transmitter. The apparatus was developed in conjunction with the Canadian Marconi Company, and now ten sets are in operation, with nine more in course of installation.

The Department's original idea of the beacon was the long-distance fog alarm, but, as experience grew, the conclusion was reached that the navigator really desired a 75-mile lighthouse available day and night, 365 days a year, and the new apparatus is designed to attain that end. The transmitter is automatic in all respects. It has as a source of power a petrol-driven electric generator of the automatic self-starting type, and the control of the whole equipment is effected by a master clock. Each beacon is given a characteristic, whereby it may be identified. In fine weather the clock automatically starts the engine once an hour and automatically puts the transmitter in operation for one minute and off for two, for a period of five minutes, when the clock automatically shuts the whole plant down. In foggy or hazy weather the light keeper manipulates what is called the fog switch and the beacon then continues to operate automatically one minute on, two off, until the light keeper puts the switch back to its fine weather position.

Details of the beacon transmitter may be of interest—see Figs. 5 and 6. Four transmitting valves are used. Each is rated at 50 watts output, and is arranged to work in what is generally called a back-to-back self-rectifying circuit. The high-tension for the anodes of the valves is obtained from an alternator driven by a 110-volt direct-current motor. This alternator supplies current at 110 volts to the primary of a transformer which raises it to 1500 volts. The secondary of this transformer is centre-tapped and its outside terminals are connected to the anodes of two valves operating in parallel. This arrangement gives a note modulated at 1000 cycles which is distinctive and can be read on a non-oscillating receiver. In addition, it has the advantage of avoiding the necessity of using a thermionic rectifier or high-voltage direct-current generator for supplying the high-

tension necessary for the valve anodes and the necessity of providing auxiliary modulating equipment. In order to obtain good regulation of the filament heating current it is supplied at 60 cycles from a separate small converter. A hinged gate at the front of the unit gives access to the valves and is equipped with an automatic safety gate switch which interrupts the alternating-current supply and renders the set dead when the gate is opened.

The brains of the equipment rest in a clock-controlled time switch. The clock has a high-grade, eight-day spring driven movement with a balance wheel escapement suitable for use either ashore or afloat. The usual hands are replaced by a disc which makes a complete revolution once an hour. This disc carries a series of pins or studs mounted on its face, which engage two light contacts possessing quick make and break features called clock contact No. 1 and clock contact No. 2. No. 1 controls the starting and stopping of the engine-driven generator and No. 2 the duration of the transmission and silent periods.

The source of power for the beacon transmitter is a 2-kW, 110-volt, direct-current generator, driven by and directly connected to a four-cylinder petrol engine rated at 4 horse-power. This unit is automatically started from a 32-volt storage battery when a load equivalent to a 75-watt lamp is switched on across its output terminals. This initial load is provided by a 150-ohm resistance connected in parallel with the energising solenoid of a 110-volt shunt relay and is switched on and off by the No. 1 contacts of the control clock.

As soon as the circuit is closed by the No. 1 contact the engine-driven generating unit starts, and when it has built up to its full pressure of 110 volts, which it does in approximately ten seconds, the shunt relay begins to operate to close the remote control contacts on the solenoid-operated starter of the motor alternator. This starter is of the progressive contact type and is adjusted, by means of an oil-filled dashpot, to bring the motor alternator up to speed in twenty seconds. The motor which drives the character disc is started at the same time and through the same operation.

Actual transmission is controlled by the second set of contacts on the time switch, which are timed relatively to the No. 1 contacts, so that transmission does not begin until one minute and forty-five seconds after the engine has been started in order to ensure that it will be running evenly and will drive the motor alternator at uniform speed under load.

The No. 2 contact on the clock energises a relay to close or interrupt the primary circuit of the transformer, which supplies high tension to the anodes of the transmitting valves. This circuit is closed for a one minute and fifteen seconds transmission period and then opened for a one minute and forty-five seconds silent period. This sequence is transmitted twice at the beginning of each hour day and night during clear weather and is repeated continuously during fog. The character disc through a keying relay makes and breaks the same circuit to form the signals of the beacon characteristic.

When the clear weather hourly operating period of six minutes is over the clock opens the energising circuit of the main starting relay, which, in turn, drops out and opens the remote control circuit of the solenoid-operated motor starter. As a result every output circuit of the generator is opened and the engine shuts down.

For continuous operating during fog a single-pole switch, arranged on the main control panel above the starting relay, is closed, short circuiting the No. 1 contacts on the clock. This action takes the control of starting and stopping away from the clock and the generating plant will continue to run so long as the engine is supplied with fuel. The transmission and silent periods are still controlled by the No. 2 contacts of the clock.

In order to draw the attention of the attendant in case of overload or if the filament of a transmitting valve should burn out, there is an alarm bell which is operated through an auxiliary relay. This auxiliary relay is energised from the 110-volt direct-current circuit in series with the overload trip coil of the circuit breaker and also through a differential relay in the filament circuit. Of the four filaments, two are connected in each side of the differential relay, and under normal conditions the two sides are balanced and the relay is inoperative, but if one valve burns out the two sides of the relay become unbalanced and it will operate to energise the auxiliary relay and, through it, close the bell circuit. After the auxiliary relay has been tripped by the operation of either the overload or the differential relay the alarm bell will continue to ring until the auxiliary relay is reset by hand.

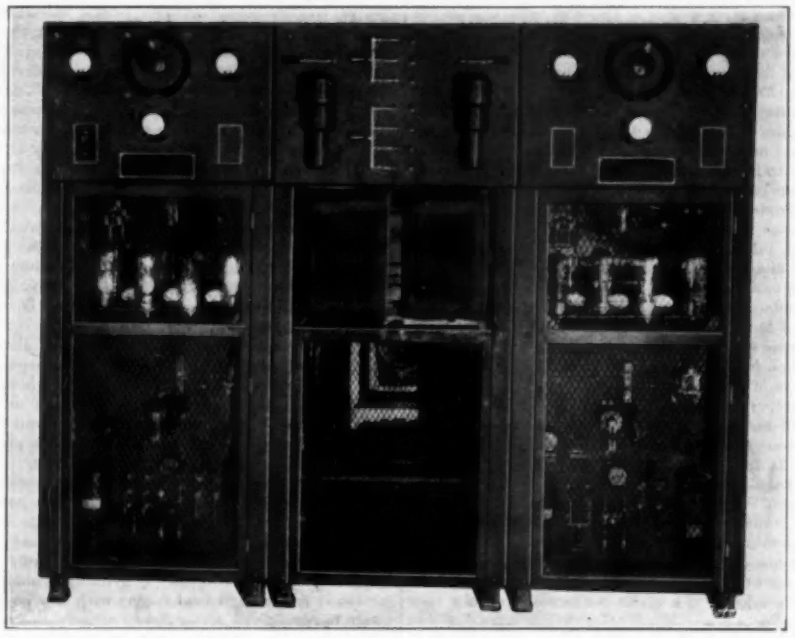


FIG. 5—TRANSMITTER FOR CANADIAN WIRELESS BEACON STATION

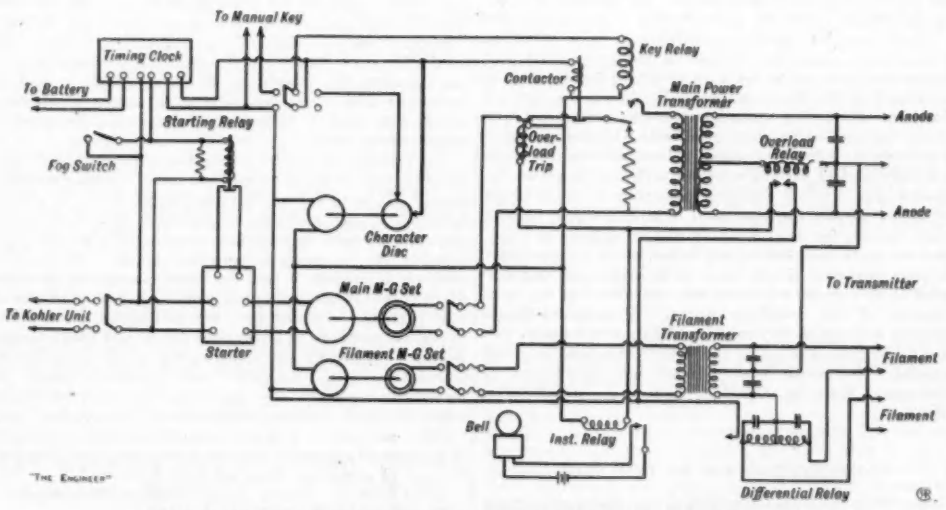


FIG. 6—ELECTRIC CONNECTIONS FOR WIRELESS BEACON TRANSMITTER

Wireless Broadcasting.

It is not generally known that Canada was a pioneer in this phase of the wireless art. The Canadian Marconi Company began its first regular weekly broadcasts from its station XWA at Montreal in December, 1920, on a wave length of 1100 m. In protecting the interests of the broadcast listener, Canada has been prominent. In the matter of clearing up ship interference Canada led the way by making treaties with ten countries, as early as 1925, arranging to have their ships stop the use of any wave in the broadcast band when ships flying their flag were on this side of the Atlantic or the Pacific.

All spark transmitters on Government stations at points where they could cause interference were scrapped and replaced by valve sets, and at the International Radio Convention at Washington in 1927, at which seventy-six administrations were represented, the policy of the Canadian Government was given international effect to, and rules were drawn up making international the regulations and arrangements which previously had been in effect in Canada and the United States.

There are to-day in Canada upwards of half-a-million wireless receiving sets and twenty-six broadcasting stations. The future of the latter is still to be decided. A Royal Commission on broadcasting was appointed to inquire into this matter more than a year ago, and its report is now being considered by the Government.

Whereas many of the original stations employed transmitters rated at from 50 to 250 watts output, there are now several stations in Canada equipped with transmitters rated at 5000 watts. As some of the stations in the United States are employing broadcast transmitters rated at 50,000 watts, it is reasonable to expect to see employed in Canada transmitters of considerably higher rating than those at present in use.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SAGS AND STRESSES IN OVERHEAD WIRES.

Sir,—I have read with interest Mr. C. G. Watson's article in your issue of June 13th, 1930, adapting Thomas's semi-graphical method of calculation to spans with supports at different levels, a case which is unanimously evaded by the text-books.

Unfortunately, the method as set out by Mr. Watson applies only to the case in which all loads are vertical. No mention is made in the article of the direction of the load of 1·4 lb. per foot in the first problem, but the figures given fit the case of a steel-cored aluminium conductor having seven steel wires and thirty aluminium wires, all 0·102in. diameter. This has a weight of 0·49 lb. per foot, and when it is loaded with a coating of ice ½in. thick and acted on by a horizontal wind force of 8 lb. per square foot the resultant load is 1·4 lb. per foot. It is therefore assumed that this is the case intended to be considered. The resultant loading is inclined at an angle $\theta = 44° 23'$ to the vertical. The cable will therefore lie in an inclined plane which is cut at that angle by a vertical plane perpendicular to that containing the two supports.

If L_1 be the horizontal span and H_1 the difference of level of the supports, the corresponding quantities L_2 and H_2 in the inclined plane will have different values. H is the distance between the feet of perpendiculars drawn from the points of support on to a line parallel to the resultant loading. If a three-dimensional model is prepared showing the various planes, it is at once apparent that H_2 (in the inclined plane) $= H_1 \cos \theta$, and as the straight-line distance between points of support $= \sqrt{L_1^2 + H_1^2}$, the value of $L_2 = \sqrt{L_1^2 + H_1^2 - H_2^2}$.

If the horizontal wind force is very great compared to the weight of the cable, θ approaches 90 deg. and H_2 approaches zero, and the "horizontal" distance between the points of support is nearly equal to $\sqrt{L_1^2 + H_1^2}$, because the resultant loading is practically at right angles to the line A B joining the points of support.

In Mr. Watson's first example $H_2 = 206 \cos 44° 23'$ $= 147 \cdot 2$ft., and $L_2 = \sqrt{(2750^2 + 206^2 - 147 \cdot 2^2)} = 2753 \cdot 8$ft.

The second example is apparently that of a steel-cored aluminium conductor 37/·110 loaded with ½in. of ice and wind pressure of 8 lb. per square foot. In this case $\theta = 40° 57'$, $H_2 = 302 \cdot 2$, $L_2 = 1621 \cdot 3$.

In Australia no ice loading is allowed for and wind pressure is taken as 15 lb. per square foot.

With small conductors θ may be as great as 70 deg., giving very considerable differences between L_1 and L_2.

The procedure described by Mr. Watson includes the step—"Calculate the relative elongation for the same sag [as under wind load] at the loading other than the given loading." This involves the assumption that the catenary would have the same form in each case. The fact that the values of L and H vary with the direction of resultant load would therefore appear to invalidate the method for purposes of exact calculation.

One method applicable—probably the simplest—is as follows:—Using Mr. Watson's, or other, method, with values of L and H appropriate to the loading, find the actual length of cable in the span, from which, by subtraction of the elastic stretch, the unstressed length is found.

Under the other loading—bare cable in still air—assume a value for the maximum tension—a suitable value is one bearing the same ratio to that in the first case as the ratio of the loadings. For this loading and tension find a second value of the unstressed length of cable by the same process as before.

Find what temperature change will cause the ascertained difference in unstressed length. This gives one connection between tension and temperature.

Guided by the results already obtained, assume other tensions, and similarly find the corresponding temperatures. By interpolation, graphical or otherwise, the tension—and sag—corresponding to any required temperature may be found.

The most convenient table of catenarian functions known to the writer is one prepared by Mr. J. S. Martin and published in the "Proceedings" of the Engineers' Society of Western Pennsylvania, November, 1922, which shows the values of "Sag Factor," "Length Factor," and "Stretch Factor" corresponding to each value of LW/T, where L=span in feet, W=loading per foot run, and T=tension adjacent to support. "Sag factor"=$\frac{\text{Central sag}}{\text{Span}}$, "Length factor"=$\frac{\text{Length of cable}}{\text{Span}}$ and "Stretch factor"=elastic stretch of cable $\div \frac{W\ L^2}{A\ E}$, A being area of cross section of cable and E its Young's modulus.

These figures—referring to spans with supports at same level—are given to seven places of decimals for values of L W/T from 0·001 to 1·200 by steps of 0·001. Differences are tabulated for convenient interpolation.

By means of these tables Thomas's method of calculating ordinary spans—supports at equal elevation—can be applied without any need for graphical interpolation.

Spans with supports at different elevations may be divided into two half catenaries, as in Mr. Watson's method, by the following formula:—

$$Z=\left(\frac{T}{W}-\frac{H}{2}\right)\left\{\frac{H}{L}-\frac{2}{3}\left(\frac{H}{L}\right)^3+\frac{8}{15}\left(\frac{H}{L}\right)^5\right\}$$
$$-\frac{L}{3}\left\{\frac{H\,W}{2\,T}+\left(\frac{H\,W}{2\,T}\right)^2+\frac{H}{13\,L}\left(\frac{L\,W}{T}\right)^2\right\}$$

where Z is the horizontal distance between the common axis of the two half-catenaries and the centre of the span, and other symbols have meanings defined above.

This formula is given, in somewhat different form, in a paper presented by Professor H. B. Dwight before the American Institute of Electrical Engineers, May 26th, 1926.

Mr. Watson's first problem has been worked out by this method, and the tension in the cable with a loading of 0·49 lb. per foot at 0 deg. Cent. is found to be 2824 lb., compared with 2803 lb. given by Mr. Watson. The tension 2803 lb. would occur at 10 deg. Cent.

The difference is small in this case, but with a greater difference in level of supports the error might be more serious.

When the lowest point in a span is near one support the level of this point is altered only slightly by considerable differences of cable tension and consequently does not provide a sensitive control for correct tension when stringing cables.

In Mr. Watson's second problem there is no point of horizontal tangency, the value of V being negative. The calculated sag applies to an imaginary point outside the span and gives no assistance in stringing the cable. For these reasons it is the writer's practice to calculate in all cases the level of the cable at the centre of the span, midway between supports, and during stringing operations to check this level with a theodolite, set up, when possible, at a point opposite the centre of the span.

A. L. Galbraith, B.C.E., Assoc. M. Inst. C.E.

Melbourne, October 15th.

POWER FROM WARM WATER.

Sir,—I have read the article devoted by The Engineer to my Cuba work in its issue of October 24th, and am surprised at the anti-scientific spirit which animates it. I beg leave so to express myself, since you, without even knowing my results, pretend to condemn them on the faith of reports, too often fanciful, of the non-technical Press, which, however, I cannot prevent from taking interest in my work and speaking of it.

It is true that in place of my affirmations, you would prefer that "the calculation on which the scheme is based were to be made public." I am surprised to be thus treated as an accused man set on the rack, and desire to say that I am accountable to nobody but myself and the friends, whom bad prophets like you did not discourage originally, for the results of costly experiments.

I will only say that I did not fail in my lectures before technical audiences—October 9th, Academy of Sciences of Havana, after my first results; then on October 22nd, American Society of Mechanical Engineers—to give figures which would probably have impressed you had you had the patience to wait for them.

The 22 kW finally produced by the Ougree turbine under a difference of temperatures of 14 deg. Cent.—27 deg.—13 deg.—were furnished by means of only a little more than 200 litres of cold water per second,* that is, one-fifth of the cold water brought up through the pipe, a big pipe bringing up much water being necessary to avoid a complete warming of water during its ascent. Well, if the totality of the cold water had been used—but it is not known as yet how to devise large turbines running under such low pressures—I should have produced $22\times5=110$ kW.

On the other hand, if reason of economy regarding the second and third tubes had not compelled me to reduce to 1·60 m. the 2 m. diameter of the first tube, the 50 per cent. larger section of the latter tube would have allowed me to receive twice as much cold water with the same depression of 3 m. in the pit and less warming, thus producing more than 220 kW.

Finally, I have shown that the efficiency of such plants increases as the square of the difference of temperatures. Now, if I had not thought myself compelled, for the sake of prudence, to immerge my first tube, then the others, in the small depths of Mátanzas Bay, I should have got an average difference of 24 deg. Cent. instead of 14 deg. Cent., giving a power three times larger—that is, 660 kW—all this without taking into consideration the much better efficiency of much larger apparatus.

As to the energy required for the maintenance of the plant, I calculated it† to be 25 per cent. of the energy produced, and I see these views confirmed by the results of my experience—3 m. depression in the pit of cold water and extraction from the condenser of 3·3 cm. of dissolved gases per litre of water.

As they are, these figures imply an amount of 330 gross kW and 250 net kW for the power available per cubic metre per second of cold water under a difference of temperature of 24 deg. C.

If I now take into account the enormous improvement resulting from very powerful apparatus in place of my 50-kW unit running at less than half load and all evident possible improvements, I estimate that in the Santiago de Cuba conditions of temperature, and in very large plants, one will obtain at least 500 net kW per cubic metre of cold water per second. It is a result conformable to our best expectations.

On the other hand, the ascertainments of all kinds I made and the precious experience I acquired allow me to think that the carrying out of such plants will probably not meet with very great difficulties and that their cost will be lower than that of the best hydraulic plants.

You do not think so. You will allow me to think that you want to judge the future with the eyes of the past. None of the technical features of present power stations will apply to these new plants.

Paris, November 7th. Georges Claude.

[We find nothing in Monsieur Claude's letter which controverts in any way the conclusions of our leading article of October 24th as to the practicability of his scheme. As we then showed, its theoretical possibilities can be worked out by anyone possessing steam tables and an ordinary knowledge of thermodynamics, while its practical possibilities can be equally well assessed by those conversant with turbine and condenser design. No amount of deep-sea experiments will alter the fact that to produce steam at 23 mm. absolute pressure continuously from water at 27 deg. Cent., using only the heat in the water itself, will require the boiler to be fed with over two hundred times the weight of the water evaporated. Again, if a vacuum of 29·8in. can be maintained in the condenser—and this far exceeds modern practice, even with circulating water at the freezing point—it is equally demonstrable that even an ideally perfect turbine working with live steam at the pressure stated would consume more than 40 lb. of steam per kWh. Hence the operation of a 50,000-kW turbine would require far more than 40 million gallons of water per hour to be supplied to the boiler, while substantially the same quantity would have to be evacuated and disposed of in a cooler condition without affecting the temperature of the incoming water. A correspondingly immense amount of very cold circulating water would also have to be got rid of under the same restrictions as to its disposal. We await with interest an opportunity of examining Monsieur Claude's figures in detail.—Ed. The E.]

ENGINEERING AID TO INDUSTRY.

Sir,—Ever since the early days of the electrical industry effort has been concentrated upon supplying energy at the lowest possible cost to consumers' terminals. During recent years much attention has also been given to the design of appliances for the more efficient utilisation of such energy.

Extensive use of many of these improved appliances is at present handicapped by the fact that, whilst in many cases the technologists of respective industries recommend their adoption, the responsible directors concerned are unwilling to authorise the necessary capital expenditure on the grounds that, in the present state of industrial depression, such capital outlay is unjustifiable. These same directors, when trade was brisk, were equally unwilling to modernise their plants because such alterations would then have interfered with production.

The reception accorded to a paper I had the privilege of delivering to the Ceramic Society at Stoke-on-Trent last week, and the following day's reference to that paper in the North Staffordshire *Evening Sentinel*, are indications that British industrialists are beginning to realise how dependent they are upon scientists and engineers for the recovery and retention of their respective trades.

It is generally admitted that British industrial supremacy during the latter years of the last century was largely the result of the early adoption in this country of engineering inventions. I suggest that the present is an opportune time for reminding leaders of industry that engineers are still able and desirous to assist them to recover their depressed trade, by advising them how they can greatly reduce their costs of production.

The following case appears to indicate the necessity of greater co-ordination between public electricity supply undertakings and industrial engineers. In the Potteries area alone, closely surrounding one of the "grid" generating stations, there are a large number of individual steam plants, aggregating many thousands of I.H.P., driving mills grinding pottery material. These mills are usually running day and night and should be therefore an attractive load for electric supply undertakings. That they are not so at present appears to be largely due to the fact that it is the existing practice to grind materials—flint stone or felspar—in large batches of, say, 8 or 10 tons to a charge. The charge is distributed over a number of units, all interconnected through mechanical gearing. The grinding of the batch is continued from ten to twenty hours until the material is reduced to the required degree of fineness. Under such conditions the starting load may be many times the mean running load.

In striking contrast to the above, a new flint grinding plant recently started in the North of France is equipped with a modern continuous feed mill into which the flints are fed at an automatically controlled and uniform rate of 30 lb. to 40 lb. per minute. This plant runs continuously, from week-end to week-end, thus providing an ideal load for an electric supply undertaking.

If the existing mills in the Potteries were driven by individual electric motors—thus ensuring a good starting diversity factor—and a much smaller charge was ground for a fraction of the time allowed for the heavy charge, a condition made possible by the use of hydraulic classifiers, the efficiency and uniformity of grinding would be greatly increased and a high load factor with low cost of power would be obtained.

The above is quoted as a mere example of the many opportunities awaiting engineers to aid industry.

London, November 17th. Leonard Andrews.

TECHNOLOGICAL UNEMPLOYMENT.

Sir,—Technological unemployment is a new name for a very old problem, one that was being discussed over a hundred years by Jean Sismondi and other noted economists. Sismondi was the originator of the famous "winch" argument, which, though fantastic as a practical possibility, throws a very vivid light on the path we are all treading. The argument may be put in this form. Suppose that use of power-driven machinery was so developed that eventually one man, supervising one huge machine, was capable of producing all the goods needed or desired by mankind. What, then, would become of all the others if they were dependent for a living on wages paid for work done? Must they starve because we insist that the only "proper" way of distributing purchasing power is in return for work done? As I have said, the argument, if one considers the possibility of reaching such a goal, is fantastic. But if one considers it as merely illustrating a very real trend in industrial affairs, it then becomes of considerable value.

The problem of problems in industry to-day is not production, not hours of work, not even "giving employment." It is to ensure that purchasing power is so distributed, in such quantity, in all places and at all times, that the capacity to consume goods equals as nearly as possible the capacity to produce goods. When that problem is settled it will be time enough to consider whether we are producing too much or too little of this or that particular commodity. But so long as all attempts to discuss problems of purchasing power and novel suggestions for regulating and distributing it, are countered by insensate cries of "inflation" and "currency crank," or by equally insensate talk—repudiated by reputable economists and men of science alike—about "immutable" and "iron" laws just so long will industry continue to struggle in a slough of despond: sinking in the mire, like Christian, because of a burden which need not be there.

Hugh P. Vowles.

Wimbledon, S.W. 19, November 17th.

A development of the initial works of the Grampian electricity scheme has been arranged. The original works, which are now well on towards completion, provide for utilising the waters of Loch Ericht, with a power-house at Ard Larich, at the west end of Loch Rannoch. Under the additional scheme the waters of Loch Rannoch will also be utilised. It is understood that the new works will include the construction of a concrete dam across the river Tummel, to the east of Dunalastair House, with an open canal of about 3 miles to Tummelbridge, in the vicinity of which a second power-house will be erected. The canal will have a depth of about 10ft., and vary in width from 16ft. at the base to about 40ft. at the top. The dam will provide a shallow lake about 3 miles in extent up the valley of the Tummel. It is expected that the new works will begin in a few weeks' time. The contractors are Balfour, Beatty and Co., Ltd.

* Respective pressures in boiler and condenser being 23 mm. and 16 mm. of mercury.

† C.R. of Ac. of Sc., November 14th, 1927.

Report on the Ultra-Violet Transmission of "Vita" Glass.*

An investigation of the ultra-violet transmitting properties of "Vita" glass when new and after intensive irradiation under the tropical sun has been carried out for Messrs. Pilkington Brothers, of St. Helens, at the Garston Building Research Station of the Department of Scientific and Industrial Research. The transmission figures given below were obtained by means of photo-electric apparatus at the National Physical Laboratory.

Twelve samples of 18–21 oz. glass were chosen at random from various sections of the manufacturer's stock by a Building Research Station representative, on February 25th, 1930. A specimen, 3in. square, cut from each of these samples was then sent to the National Physical Laboratory and its ultra-violet transmission curve determined.

Table I. gives the average transmission of the twelve new specimens at various wavelengths, as well as the transmissions of the best and worst specimens. The variation, which is particularly marked at the lower wavelengths, can to a large extent be accounted for by variations in thickness of the original samples.

As a rapid test of the decrease in ultra-violet transparency which occurs when "Vita" glass is exposed to strong sunshine, twelve specimens similar to those originally tested were exposed on an upper deck of the m.v. "Alcantara" during a six-week voyage to South America and back. On their return these specimens also were examined at the National Physical Laboratory, the results being summarised in Table II.

In order to find whether the six weeks' exposure was sufficient to bring the "Vita" glass specimens to a stable, "solarised" condition, additional specimens from three of the samples were aged under a mercury arc lamp for a period of seventeen hours and exposed with the remaining twelve specimens on board ship.

The artificial ageing of "Vita" glass under the mercury arc causes a much greater reduction in its ultra-violet transparency than does exposure to the sun. Subsequent exposure to the sun of glass aged in this way causes a partial rejuvenation and it was thought that if, after the voyage, the transmission of the directly solarised specimen in each of the three cases studied exactly matched that of the rejuvenated specimen, it could be assumed that the condition of the solarised specimens was such that further prolonged exposure to sunshine could cause no further loss of transparency. An examination of Table III. indicates that this was almost the case. In this table, too, the transmissions of the three specimens after complete ageing under the mercury arc are also shown. The marked rejuvenation of these specimens during the voyage shows that the behaviour of "Vita" glass in sunshine cannot be deduced from artificial "solarisation" tests under the mercury arc without serious risk of error.

Re-exposure of completely aged specimens to the mercury arc for a further period of seventeen hours under a screen of ordinary window glass 6 mm. thick also caused partial rejuvenation of the specimens—see Table III. The method apparently yields final transmission values not far below those obtained after exposure to sunshine.

Table I.

Wavelength (A.U.)	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600
	Transmission (per cent.).										
Best sample	3	11	25	43	58	71	81	86	88	89	90
Average sample	1	7	20	37	53	67	77	84	87	89	90
Worst sample	—	5	16	33	49	63	75	82	85	87	88

Table II.

Wavelength (A.U.)	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600
	Transmission (per cent.).										
Best sample	—	2	13	29	46	61	73	82	86	88	89
Average sample	—	—	8	23	40	57	71	81	85	87	88
Worst sample	—	—	6	19	36	54	69	80	84	86	87

Table III.

Sample.	Condition of spec.	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600
		Transmission (per cent.).										
A	a	3	11	25	43	58	71	81	86	88	89	90
	b	—	2	13	29	46	61	73	82	86	88	89
	c	—	1	5	13	29	46	60	70	77	81	83
	d	—	1	9	25	42	58	72	82	86	87	87
	e	—	1	10	25	41	57	71	80	85	87	88
E	a	—	5	16	33	49	63	75	82	85	87	88
	b	—	—	6	19	36	54	69	80	84	86	87
	c	—	—	2	9	21	37	52	66	75	79	81
	d	—	—	4	16	34	53	69	79	84	86	87
	e	—	—	4	15	32	49	63	74	81	84	86
G	a	1	7	21	38	53	65	76	83	87	88	89
	b	—	—	8	23	40	57	70	80	85	87	88
	c	—	1	4	11	24	40	54	66	75	79	81
	d	—	—	6	20	38	56	70	80	85	87	88
	e	—	—	7	20	37	53	66	76	82	85	87

a New. b After solarisation under tropical sun. c Completely aged under mercury arc. d Ditto, rejuvenated under tropical sun. e Ditto, rejuvenated under arc with ordinary glass screening.

* Report made by the Garston Building Research Station of the Department of Scientific and Industrial Research.

The Opening Out of Cofton Tunnel, London, Midland and Scottish Railway.†

By ROBERT TOWSON McCALLUM, M. Inst. C.E.

The objects of the works described were the removal of an old and small double main-line tunnel, 440 yards long, and making the open cutting so formed wide enough to take two additional lines on its eastern side.

No records of the actual construction of the tunnel and of the strata passed through were available, and the design for the slopes of the new cutting had to be based on such information as was available in the existing approach cuttings. This information showed that there was some disturbance of the strata through which the tunnel had been driven, apparently due to the Longbridge fault, which was shown on the revised 6in. map of the Geological Survey* to traverse the tunnel in a roughly north-and-south direction. The design was therefore regarded at the outset as tentative.

A description is given of the various methods considered for felling the tunnel, the method adopted being to construct a temporary diversion for the main lines on the eastern side of the cutting about 3ft. above springing level of the arch, and so have full possession of the existing lines to drop the arch as convenient.

The excavation over the tunnel was begun in March, 1926, and it soon became evident that the ground was folded and much faulted, and large cavities associated with faults were found over the tunnel. A remarkable feature of several of the faults was the flat angle of their planes, and as these were also slickensided, a tendency for the material to slip off them soon became manifest. One of these slips occurred at a point about halfway along the tunnel on the new west slope, and in November, 1926, when the level of the excavation was 12ft. above the tunnel arch, a mass of about 5000 cubic yards suddenly slid down a fault plane into the open cutting.

At this time there was a continuous exposure of the strata along the length of the tunnel except for about 80 yards at the north end. It was desirable to know if there was further faulting in this hidden length, and as excavation in this length could not then be conveniently carried out, the hidden structure had to be deduced from geological evidence. The geology of the cutting, based on a survey then in progress, is described, and it is shown how from this survey it was deduced that there was faulting in the hidden length with a total throw greater than that of any of the faults already exposed. For reasons fully explained it was decided to construct a retaining wall in trench at the back of the tunnel along its west side, at first so as to cover the fault on which the big slip had occurred and another fault, to the north, on which a further similar slip was threatening, and then subsequently to extend it to the north face of the tunnel, making a length of 302 yards. This work was completed by the end of 1927.

Meanwhile, during the spring and early summer of 1927 serious troubles were also being experienced in the east slope of the cutting, with slips associated with the faults; and this slope was in consequence flattened throughout to a uniform slope that was flatter than the slope of the faults. This work was completed down to 12ft. above the tunnel arch by the end of July, 1927, and at this level the new slope remained stable, but when a cut along the toe was taken out below this level the slope broke in three areas.

The diversion scheme for removing the tunnel had now to be abandoned, and in its place the scheme for dropping the arch in short lengths during periods of possession of the main lines in their existing position had to be adopted. The work involved in this new scheme was designed to be carried out in six stages, and these, together with the details of the work for the fourth stage, which was the actual felling of the arch, are described.

The date fixed for felling the first length of arch was Sunday, May 13th, 1928, and in the preceding week a length of 410ft. of bared arch at the north end was divided by narrow chases into eight sections and prepared for demolition. On Friday, May 11th, the southernmost section, No. 8, which contained the cast iron curb forming the eye of one of the shafts, suddenly collapsed, killing four men, and on the following morning the No. 5 length, which also contained the eye of a shaft, began to fail and was immediately demolished. As a consequence the remaining length of tunnel arch then bared, approximately 265 yards, was felled forthwith, the main lines being re-opened for traffic on the following Tuesday. Details of these operations are given, as well as some interesting information with regard to the effect of explosives on the arch and side walls and the effect on unprotected permanent way of the fall of the arch.

Work was then resumed on the western slope along the length of 140 yards of arch still to be bared. In this slope there were three areas, associated with faults, of which the stability was doubtful, and they were accordingly being lightened. Early in June, 1928, one of these areas definitely broke, and the retaining wall was therefore extended to the south face of the tunnel. This work, which was somewhat difficult to carry out, was completed by the end of the year, the whole length of wall as built being 449 yards.

The remaining 140 yards of tunnel arch was then bared, and commencing on the night of Saturday, January 26th, 1929, its demolition was carried out in one operation, and the lines were reopened ready for traffic in twenty-one hours.

The remaining works carried out to finish the cutting included the treatment of the slips in the east slope.

The condition of the tunnel structure at the time of demolition is described, and attention is drawn to certain undesirable features of design and subsequent maintenance. It is shown that difficulties must have been encountered during the construction of certain lengths of the tunnel, including the two lengths that failed, and that these difficulties were caused by faults that were responsible for some of the slips during the recent excavations.

The conditions causing the various slips, which were such an outstanding feature of the excavations, are analysed and the slips are classified into three distinct types.

In conclusion, it is shown that the construction of the tunnel was apparently not originally contemplated, and that it was in fact not started until serious slipping in the slopes of the open cutting had occurred at each end of the faulted zone. It is further shown that in siting the line so as to cross the ridge below what is so obviously its lowest point, no doubt for economy in construction of the railway, the faulted zone was unwittingly found, for the depression exists because it is the area in which the folding and faulting cross the ridge.

* Worcestershire X., S.W., 1924.

† Abstract of a paper to be brought forward for discussion at the Institution of Civil Engineers.

SIXTY YEARS AGO.

On the evening of November 14th, 1870, besieged Paris was heartened by the receipt of agreeable news. By pigeon post it had heard that after two days of fighting, Orleans had been retaken from the Prussians with a large number of prisoners, and quantities of ammunition and provisions. It was the first real victory in four months of war. On the 15th more encouraging news was received. It was rumoured that two of the armies of the provinces had united and that Chartres had been retaken. Meanwhile the Parisians were maintaining their intense activity in the defence of the capital. From our correspondent's letter in our issue of November 25th, received, as usual, by balloon post, we learn something of what that activity on the part of the Parisian engineers and scientists was doing for the nation. The soldiers on the ramparts were suffering by exposure to the weather. Monsieur Balard, therefore, proposed to make their clothing impermeable by dipping it in a solution produced by reacting on sulphate of alumina with acetate of lead. Sulphate of lead was precipitated. The clear liquor presented a solution of acetate of alumina. A substance "having all the qualities of fatty matter," was deposited in the texture of any garment or fabric steeped in the solution and allowed to dry. Clothes so treated, it was claimed, were completely impermeable to water, and the effect was said to endure for years. Great activity was being displayed in converting old types of guns into up-to-date weapons with breech-loading mechanism. By the middle of November means had been organised which were sufficient to convert the weapons at the rate of 1200 a day. It was anticipated that by the end of the month 135,000 converted weapons would be in the hands of the National Guard. In order to hasten the conversion the breech pieces were being made entirely of bronze and it was stated that the guns so fitted could stand 750 rounds without sensible deterioration. When the siege began the city possessed large stocks of flour. In addition, it had 300,000 quintals of wheat, but it possessed no mills wherewith to grind it. The great mills at Corbeil and elsewhere were in the hands of the enemy. By the middle of November, 170 pairs of stones had been set up and were grinding 3000 quintals of wheat per day. The ominous fact had, however, to be faced that Paris had two million mouths to feed. A sidelight on the condition prevailing in the capital is thrown up by the fact that the siege was not allowed, except for a short time at the beginning, to interrupt the meetings of the Academy of Sciences. In his letter in the issue quoted, our correspondent reported that the Academy had been considering the ballistic force of powder, nitroglycerine and dynamite, and had been devoting some attention to aeronautics, both topical subjects. In the second named connection, the Academy had expressed a very decided opinion against "aerostats heavier than air moved by steam or other power."

The recent auction sale of the plant and machinery at the old Cleveland Dockyard, Middlesbrough, was the last phase in the passing of perhaps the most famous shipbuilding yard on the Tees. Before and during the war this yard turned out hundreds of large boats, including the famous "Q" boats and monitors, but since 1923, despite drastic reorganisation, there have been no ships built there.

Tubes for High-Pressure Water-Tube Boilers.*

By S. F. DOREY, M.Sc., Wh. Ex.

Section I.

Tube Stresses.

The stresses in a boiler tube subjected to internal pressure may be considered under three headings, viz., (i.) stresses due to internal pressure, (ii.) stresses due to the difference of temperature between the inner and outer walls of the tube, (iii.) resultant stresses due to temperature and pressure.

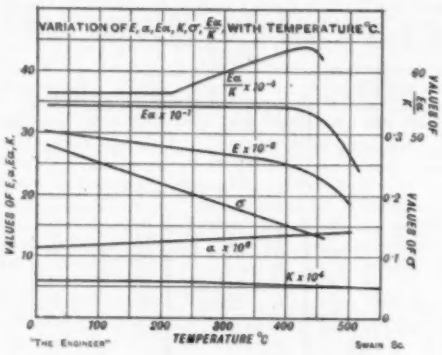


FIG. 1

(i.) *Pressure Stresses.*—In the case of a thin tube the stress is considered to be uniform through the wall of the tube, and in circumferential stress is given by the well-known formula :—

$$f=\frac{p\,d}{2\,t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where f=stress in pounds per square inch ;
d=internal diameter of tube in inches ;
t=thickness of tube wall in inches ;
p=internal pressure, pounds per square inch.

It is usual to neglect the effect of the longitudinal stress, which is only one-half that given above.

Equation (1) forms the basis for most rules formulated for the purpose of readily calculating the thicknesses of tubes, steam pipes, boiler shells, &c.

As the ratio of thickness of tube to diameter increases, the tube can no longer be considered as a thin shell, and stresses require to be calculated by means of Lamé or other equations for thick cylinders.

(ii.) *Temperature Stresses.*—The difference in temperature between the inner and outer walls of a tube causes a stress to be set up in the material due to the unequal expansion of the various layers of the material. A method for calculating these stresses has been developed by J. Case, and is given in his book "Strength of Materials." The equations have been reduced to a more simple form by J. G. Docherty, "Proc.," I. Mech. Engineers, 1928.

The temperature gradient across the wall of the tube will depend upon the rate of heat transmission from the hot gases to the water or steam in the tube, and can be determined from the heat flow equation—

$$Q=\frac{2\,K}{D}\times\frac{\theta_1-\theta_2}{\log_e k} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where Q=heat transmission per unit time per unit area of outside surface ;
D=external diameter of tube ;
K=coefficient of conductivity ;
k=ratio of outside diameter to inside diameter ;
θ_1=temperature at outer wall ;
θ_2=temperature at inner wall.

For mild steel at ordinary room temperature, K may be taken as 6×10^{-4} lb. calories per degree Centigrade per inch per second, but its value decreases slightly with increase of temperature. For any particular case the value of Q, the heat flow per square foot in lb. calories per second, is known, and the temperature gradient in degrees Centigrade is then given by—

$$\theta_1-\theta_2=\frac{Q\,D\log_e k}{12\times10^{-4}}\text{ deg. Cent.} \quad . \quad . \quad . \quad (3)$$

Having determined the temperature difference between the inner and outer walls of the tube, expressions can be obtained for the hoop, radial, and axial stresses.

(iii.) *Resultant Stresses due to Temperature and Pressure.*—The resultant stresses in any one direction are obtained by adding together stresses in that direction, due to both temperature and pressure, and if a small element at the inner or outer surface of the tube wall is considered, it can be shown that stresses acting upon it can be determined from the following three equations, viz.:—

$$\left.\begin{aligned} x&=p\,X_p+M\,X_T\\ y&=p\,Y_p\\ z&=p\,Z_p+M\,Z_T\end{aligned}\right\} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where x, y, and z are hoop, radial, and axial stresses respectively, p is the internal pressure—

$$M=\frac{E\,\alpha}{(1-\sigma)}(\theta_1-\theta_2);$$

where E=Young's modulus of elasticity ;
σ=Poisson's ratio ;
α=coefficient of expansion ;
$(\theta_1-\theta_2)$=temperature difference as determined by equation (3) ;
X_p, Y_p, Z_p are pressure stress factors.

For inner surface—

$$X_p=\frac{k^2+1}{k^2-1};\ Y_p=-1;\ Z_p=\frac{1}{k^2-1}$$

and outer surface—

$$X^1{}_p=\frac{2}{k^2-1};\ Y^1{}_p=0;\ Z^1{}_p=\frac{1}{k^2-1}$$

X_T and Z_T are temperature stress factors—

For inner surface—

$$X_T=Z_T=\left\{\frac{k^2}{k^2-1}-\frac{1}{2\log_e k}\right\}$$

and outer surface—

$$X^1{}_T=Z^1{}_T=\left\{\frac{k^2+1}{2(k^2-1)}-\frac{1+\log_e k}{2\log_e k}\right\}$$

For the complete expressions, see paper by Docherty (*loc. cit.*).

Having obtained these stresses in three directions at right angles, the limiting conditions for safety will depend upon the value of the simple tensile strength equivalent to these three stresses combined. Many hypotheses have been advanced for ascertaining the criterion of strength under combined stresses, most prominent among which are Haigh's strain energy theory and the maximum shear stress theory or Guest's Law. Within certain limits, it can be shown that there is very little difference between the values of the equivalent simple stress f given by either of these hypotheses. Haigh's theory, though giving more consistent results over a wide range, is more difficult to apply than Guest's Law, so that the latter is often preferred.

Using Haigh's theory the conditions of safety are determined by the expression—

$$\frac{x^2}{f^2}+\frac{y^2}{f^2}+\frac{z^2}{f^2}-2\,\sigma\left(\frac{x\,y}{f^2}+\frac{y\,z}{f^2}+\frac{x\,z}{f^2}\right)\geqslant 1 \quad . \quad . \quad (5)$$

and in the case of Guest's Law, we have—

$$\left(\frac{x}{f}-\frac{y}{f}\right)\text{ or }\left(\frac{y}{f}-\frac{z}{f}\right)\text{ or }\left(\frac{z}{f}-\frac{x}{f}\right)\geqslant\pm1 \quad . \quad (6)$$

where x, y, and z are obtained from equations (4).

The values of E, α, σ, and K require comment. Although these are so-called constants, their values vary for the class of material used for tube making and also with temperature. In the case of E, α, and K there is a fair amount of published information for different grades of steel over a wide range of temperatures. There is little available information with regard to the effect of temperature upon Poisson's ratio, but for carbon steels σ can be calculated from the values of the modulus of elasticity in tension and modulus of rigidity in torsion at various temperatures, given in Engineering Research Special Reports No. 1, the relationship being given by—

$$\sigma=\frac{E}{2\,N}-1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

Fig. 1 shows the variation of E, α, σ, K, and the products $E\,\alpha$ and $\frac{E\,\alpha}{K}\times10^4$, with temperature for ordinary mild steel used in the manufacture of boiler tubes. The values of E lb. per square inch are the mean of those given for 0·17 C and 0·24 C steel in E.R.S.R. No. 1, those for α being the mean for 0·09 C and 0·22 C steel—see Driessen's results for 0·09 and 0·22 carbon steels, International Critical Tables, Vol. 2, page 470.

The values of K are taken from the experimental results of K. Honda and T. Simidu—Science Reports, Tôhoku University, Sendai.

The approximate values of σ calculated by means of equation (7) above are also shown in Fig. 1.

It will be observed that at temperatures above 450 deg. Cent., the value of E falls off rapidly, and also that $E\,\alpha$ is practically constant up to 400 deg. Cent. (752 deg. Fah.). For the purpose of stress calculations above 750 deg. Fah. it would therefore appear that no reliability can be placed on the values of E for ordinary mild steel, and consequently on the values of the stresses deduced by the theory of elasticity. For higher temperatures that might possibly arise in superheater tubes, it is safer to assume that after a period of time plastic conditions ensue and the stress becomes uniform across the tube wall.

Fig. 2 shows the variations of maximum stress obtained by employing Haigh's strain-energy theory for tubes of 1¼in., 2in., 3in., and 4in. external diameter, for various values of k and internal pressures from 250 lb. per square inch and upwards. In the case of Fig. 2, the heat transmission rate assumed is 40,000 B.Th.U. per square foot per hour. This heat transmission rate is considered applicable for fire row tubes for marine boilers. It will be observed that all these curves show a distinct minimum point, which, incidentally, is more marked as the heat transmission rate is increased. Fig. 3 shows similar calculations for 1¼in., 2in., and 3in. o/d tubes, with a heat transfer rate of 80,000 B.Th.U. per square foot per hour, a rate which might be obtained in the fire row of land boilers or highly forced naval boilers under certain conditions. The effect of the heat intensity on the walls of the tube is shown by the abrupt rise of stress as the thickness of the tube is increased above the optimum value. It will thus be apparent that at high heat transfer rates, increase of thickness of tube walls above the optimum value does not provide an increase in factor of safety ; on the contrary the material is subjected to higher stresses. Thus, on the one hand, if the thickness of the tube be decreased, an increase of stress arises on account of the pressure stresses, while on the other hand, if the thickness is increased, greater stresses are included due to the temperature effect.

With low rates of heat transfer the rise due to tempera-

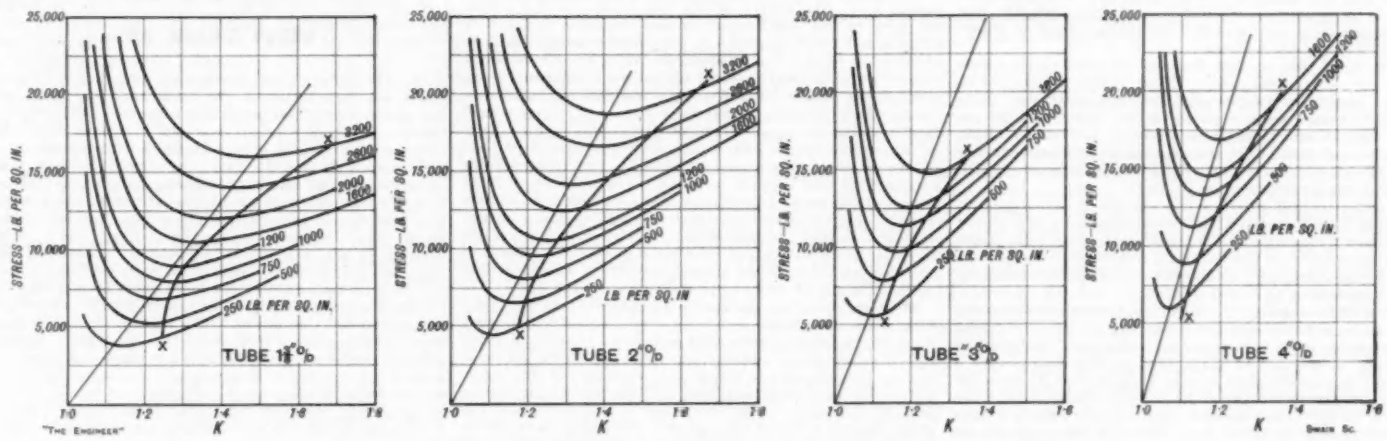


FIG. 2—HEAT TRANSMISSION RATE 40,000 B.TH.U. PER SQUARE FT. PER HOUR

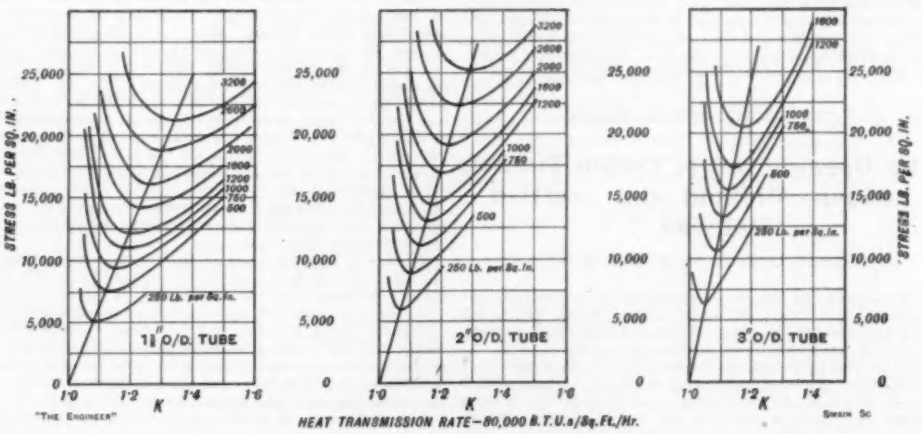


FIG. 3

* Institute of Marine Engineers, Tuesday, November 11th. Abridged.

ture stresses is less marked. It will be observed that the rise of stress over a wide range of tube thickness is slight. In each of the diagrams of tube stresses it will be found that a straight line can be drawn from the origin to pass through practically all the minimum values of resultant stress for different working pressures, and such lines have been drawn in the figures shown. Fig. 4 is an interesting diagram which has been obtained from calculations made in a similar manner to those given in Figs. 2 and 3. By means of this diagram it is possible to obtain with a reasonable degree of accuracy the optimum value of k and the resultant maximum combined stress for any diameter of boiler tube for any heat transfer rates encountered in present water-tube boiler practice.

The working pressures in pounds per square inch are shown as abscissæ to the right of the origin, values of k as ordinates, and values of maximum combined stress as abscissæ to the left of the origin. The numbers against the radiating lines are the products o foutside diameter of tube

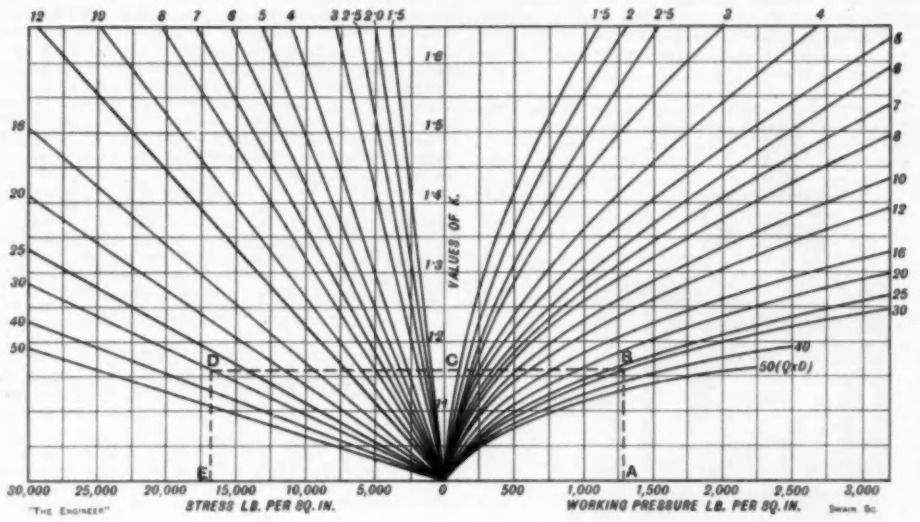


FIG. 4

in inches and heat transmission rate in pounds calories per square foot per second—for heat transmission rate in B.Th.U. per square foot per second multiply numerals by 1·8.

Section II.

Tube Temperatures.

The temperature distribution through the walls of a boiler tube may be represented qualitatively by the diagrams (*a*) and (*b*) in Fig. 5, in which (*a*) represents a water tube and (*b*) a superheater tube.

These diagrams also illustrate the reduction in effective temperature head due to difference in the resistance to heat transmission offered by the water film and the superheated steam film. The overall heat transmission coefficient will depend largely upon the velocity of the media on each side of the tube wall.

With increased hot gas velocity more of the cold gas film will be swept away and the greater the heat transfer rate. The same applies to the inside of the tube. With water

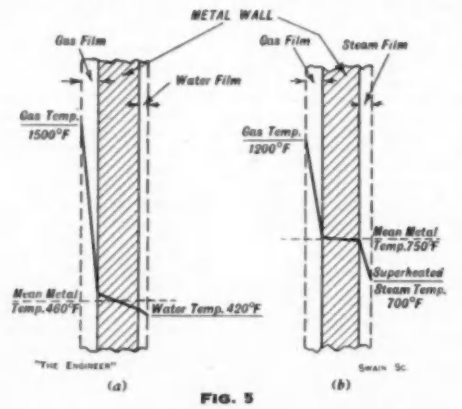


FIG. 5

tubes it has been shown by experiment that the velocity of the water when it is increased above 1ft. per second, has little effect on the overall transmission coefficient, whereas for superheated steam it may be necessary to employ high speeds in order to keep the tube temperature within satisfactory limits. For superheater tubes, there also appears to be a critical point above which any further increase of velocity has little influence in the coefficient of heat transfer, this critical velocity increasing with increase in diameter of tube. With good circulation and reasonably clean surfaces, no great error is made in assuming that the temperature of the inner surface of the tube is the same as that of the water when the outer surface is in contact with the hot gases of combustion. Although increase in velocity above about 3ft. per second does not have any appreciable effect on the rate of heat transfer, it is important that the steam bubbles should be quickly swept off the tube wall, otherwise a group of bubbles may coat the surface with a film which may lead to overheating.

To find the temperature of the metal wall of a superheater tube, the following method may be employed :—

Let h_g = heat transmission coefficient for gases to metal ;
h_s = heat transmission coefficient for metal to steam ;
T_g = temperature of gases ;
T_m = temperature of metal ;
T_s = temperature of steam.

Then, since the total heat transmission remains the same

$$h_g\,(T_g - T_m) = h_s\,(T_m - T_s).$$

whence
$$\frac{h_s}{h_g} = \frac{T_g - T_m}{T_m - T_s} = \varphi \quad . \quad . \quad . \quad . \quad . \quad (8)$$

and
$$T_m = \frac{h_g\,T_g + h_s\,T_s}{h_s + h_g} = \frac{T_g + \varphi\,T_s}{\varphi + 1} \quad . \quad . \quad . \quad . \quad (9)$$

In the ordinary type of convection superheater, *i.e.*, not exposed to radiant heat of the flame, and it is extremely doubtful whether any other type will be used in marine work unless indepedently fired and so definitely controlled, the heat transmission in B.Th.U per square foot of heating surface per hour is low and the temperatures of the inner and outer surfaces are for all practical purposes identical. Fig. 6 shows the temperature drop across the walls of 3in. and 1¾in. o/d tubes subjected to heat transfer rates of 40,000 and 8000 B.Th.U. per square foot per hour respectively plotted against working pressure in pounds per square inch. From this diagram it will be seen that with the ordinary small superheater tubes in general use the temperature difference between the inner and outer surfaces of the tubes does not reach 10 deg. Fah. even for very high pressures requiring thick tubes.

It will be observed that increasing φ above 20 has very little effect on the metal temperature, and with $\varphi = 30$ the tube temperature is only a few degrees above the steam temperature. As the value of φ increases the overall coefficient of heat transmission becomes closer to the value of the coefficient for gas to metal.

An investigation to obtain heat transmission data under conditions similar to those existing in an actual water-tube boiler was carried out under the supervision of H. O. Croft, and was published in University of Illinois Bulletin, No. 168. In these experiments steam was generated in a boiler consisting of a single water-tube so arranged that water circulation occurred under conditions similar to those in a Babcock and Wilcox boiler, the heat being obtained by burning illuminating gas and passing the products of combustion parallel to the axis of the tube. The coefficient of heat transmission of the apparatus was found to vary with (i.) the rate of gas flow, (ii.) the temperature difference between flue gas and water, (iii.) the steam pressure, (iv.) the temperature of the hot gases. The mass flow of gases varied from 0·15 lb. to 0·51 lb. per square foot of flow area per second, the temperature of hot gases varied from 900 deg. to 1700 deg. Fah. and steam pressures from 20 lb. to 160 lb. per square inch absolute. Various rates of water circulation were tried, and it was found that the water velocity had slight effect on the overall coefficient of heat transmission. The following empirical formula was determined from the results :—

$$K_c = 0{\cdot}000977\,\Delta T + 0{\cdot}0025\,T_w + 0{\cdot}0855\,W_s + 0{\cdot}00294\,T_g - 1{\cdot}83$$

where K_c = overall "convection coefficient" of heat transmission per square foot per degree Fahrenheit per hour ;
ΔT = log. mean temperature difference between flue gases and water in tube ;
T_w = temperature of water in tube in degrees Fah.;
W_s = rate of gas flow $\left(\frac{W}{A}\right)$ in pounds per minute per square foot of gas passage area ;
T_g = average temperature of gas in degrees Fah.

The writer has simplified this formula for practical use as follows, viz.:—

$$h_c = 0{\cdot}0011 + 0{\cdot}0014\left(\frac{w}{a}\right) \quad . \quad . \quad . \quad . \quad (10)$$

where h_c = overall transmission coefficient in B.Th.U. per square foot per second per degree Fah., and may be taken as h_g (hot gas to metal) ;
$\left(\frac{w}{a}\right)$ = mass flow of gas in pounds per square foot per second.

In this form the equation (10) is similar to that adopted by Osborne Reynolds, who expressed the heat transmitted per unit of surface per degree temperature difference per unit time as—

$$h = A + B\,\varrho\,v,$$

where A and B are constants, ϱ is the density of the fluid, and v its velocity.

In an interesting paper entitled "The Rational Use of Heat Transmission Factors on Design"—"Trans." of I.E.S.S., Vol. LXXII.—J. S. Brown has analysed numerous experiments carried out by R. Royds, which are described in various papers in the "Transactions" of the Institution of Engineers and Shipbuilders in Scotland, and finds that the results may be expressed in the form—

$$h_g = A\left(\frac{w}{a}\right)^{\frac{1}{3}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

where A is a constant and for the range of experiments quoted is 0·0014. The above equation only holds good up to, say, 700 deg. Fah. Above this temperature the radiant heat factor and specific heat of gas will augment the heat transmission. Brown suggests that the case of the flame tube would appear to be met by the equation—

$$h_g = 0{\cdot}0021\left(\frac{w}{a}\right)^{\frac{1}{3}} \quad . \quad . \quad . \quad . \quad (12)$$

The empirical formula suggested by Brown can be shown to be practically correct from theoretical considerations, and is particularly useful for handling by engineers. It is a slight modification of the Nusselt equation—

$$h = A\left(\frac{w}{a}\right)^{0{\cdot}786}$$

where A may be taken as 4·11 for air and 7·68 for superheated steam, the temperatures in each case being very moderate.

The writer has therefore decided to adopt this type of formula, and has applied it to the experimental results of Sneeden, McIntyre, and Croft, the following equations being deduced, viz.:—

$$h_g = 0{\cdot}0025\left(\frac{w}{a}\right)^{\frac{1}{3}} \quad . \quad . \quad . \quad . \quad (13)$$

$$h_s = 0{\cdot}0052\left(\frac{w}{a}\right)^{\frac{1}{3}} \quad . \quad . \quad . \quad . \quad (14)$$

For water-tube boilers the value of $\left(\frac{w}{a}\right)$ for the mass flow of hot gases is seldom greater than 1·5 through the superheater tubes, and in the case of marine work is of the order of about 0·5 lb. per square foot of flow area per second.

The above equation for h_s may be considered as suitable for superheated steam up to a temperature of 300 deg.

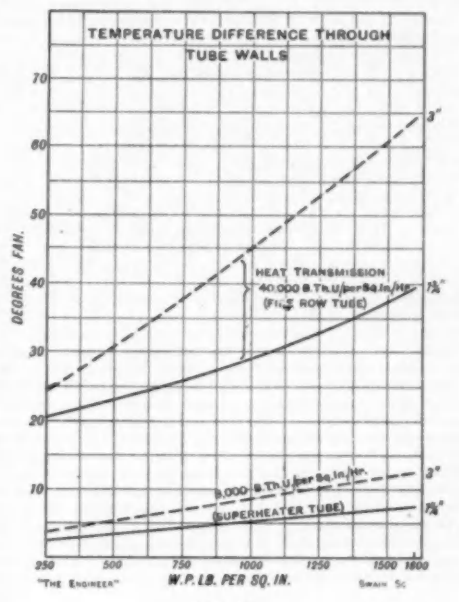


FIG. 6

Fah., the specific heat of steam being taken as 0·52 compared with 0·25 for hot gases. For high pressures and high temperatures the value of the constant 0·0052 would require to be correspondingly increased, and for all practical purposes may be taken as—

$$\frac{\text{mean specific heat of steam}}{100}$$

Taking a value of $\left(\frac{w}{a}\right) = 1$ for hot gases, then for $\varphi = 30$ the mass flow for steam is given by—

$$\left(\frac{w}{a}\right)^{\frac{1}{3}} = \frac{30\,h_g}{0{\cdot}0052} = \frac{0{\cdot}075}{0{\cdot}0052} = 14{\cdot}42$$

and
$$\left(\frac{w}{a}\right) = 55 \text{ lb. per second ;}$$

and for $\varphi = 20$

$$\left(\frac{w}{a}\right) = 29{\cdot}8 \text{ lb. per second.}$$

From this it will be apparent that for any gas flow rates the area of steam flow can be adjusted to keep the temperature of the metal as close as possible to the steam temperature. It follows from the foregoing that, with constant gas flow and increased steam pressures, the specific heat of steam will increase slightly and mass flow could be correspondingly reduced with reduction of drop of pressure through superheater and without increase of tube temperature. It also follows that since specific volume decreases with pressure, lower steam velocities can be employed with high-pressure steam than with low-pressure steam for the same degree of superheat or, conversely, by employing high mass flow at high pressures, without increase of energy cost compared with much lower mass flow rate, the metal temperatures can be considerably reduced.

The existence of any scale on the internal surface will affect considerably the temperature of the metal.

It is, however, evident that if the water-tube boiler, whether for high or low pressure, is to be a success in marine practice, absolutely pure feed water is essential. Experience has shown, however, that at high pressures distilled water is liable to set up corrosion, and it has been necessary to make the water slightly alkaline.

Brief mention might be made here of the effect of increase of pressure on the circulation. Münzinger and other authorities agree that the size of bubbles decreases

with the rise of pressure, and that circulation slows down. Smaller steam bubbles, however, mean more solid water and less overheating of tube metal, so that any reduction in circulation is counteracted to a certain extent. Hartmann has experimented on a coil of small tubing 140ft. long, in which the coils were close against each other, and found that at a pressure of 1470 lb. per square inch, water circulation took place under a small supply head without any overheating of the tube. In the case of the Benson boiler it is claimed that the best results are obtained at the critical pressure, viz., 3200 lb. per square inch, at which point the steam and water have the same density and the change from water to steam takes place instantaneously without the formation of bubbles. Moultrop and Engle—I. of E. and S.S., February 11th, 1930—state that their experience with 1400 lb. per square inch boilers and water cooled furnace walls does not indicate that forced circulation is necessary or desirable. Löffler, however, considers that forced circulation is desirable for pressures about 1500 lb. per square inch. It would, therefore, appear that provided the design of boiler is satisfactory as regards feed arrangements, water circulation should be satisfactorily maintained at very high pressures. It is claimed, however, by some boilermakers that as a result of tests carried out, tubes of comparatively small diameters are preferable, as when using tubes of large diameters the water circulation has been stopped due to several steam bubbles forming together and completely blocking the tube.

To ensure a satisfactory temperature of metal in superheaters the position and design is of the greatest importance. The exigencies of the service do not permit of radiant superheaters in marine work, and even with the convection type of superheater special care should be taken to prevent radiant heat from the fire reaching the tubes, particularly in the case of coal-fired boilers, as, owing to reduced flow of steam during manœuvring, working at low output and after stoppage the tube temperature will become uniform and tend towards the gas temperature with ultimate failure of the tubes. One special point might be mentioned in regard to steam flow in superheaters. In all calculations that are made, it is assumed that the velocity is the same in all the different tubes. This cannot be the case in practice with the usual type of headers fitted. The flow through some tubes will be much greater than in others, with consequent overheating of those tubes with reduced flow as has been evidenced in some cases by superheater tubes being at a dull red heat. Correct flow can only be obtained with equal distribution, and this is a point which will need special attention with the high superheat temperatures now being adopted. Correct steam distribution can be obtained with a multiple loop, single pass design of superheater, the inlet to the saturated header being on the end opposite to the outlet superheater header. With this construction the length of steam travel is the same for all sections of the superheater, each unit drawing its proper share of steam. It might be of interest to mention that Moultrop and Engle—*loc. cit.*—in the discussion to their paper state that in the third design of high-pressure boiler — 1400 lb. per square inch — the arrangement of the superheater on the multiple loop single pass principle made the use of the expensive alloy tubes used in the second design—1400 lb. per square inch—unnecessary. It should also be borne in mind that the final steam temperature is a mean temperature, and it is quite possible that owing to variations in gas flow and temperature the steam delivered by certain tubes may be considerably in excess of the mean exit temperature. This particularly applies to those cases in which it is not possible to arrange the superheater with the hottest steam in the coolest gas zone, that is, with the entering saturated steam passing through the hottest gas zone. Special care should be taken that the gas distribution and velocity are uniform across the superheater in order to prevent any possibility of variation of heat transmission and hot spots.

(To be continued.)

A Photo-Electric Bitumen Estimating Apparatus.

An apparatus for determining the soluble bitumen content of asphaltic materials, the general principle of which was worked out in the laboratory of the Limmer and Trinidad Lake Asphalte Company, Ltd., is being made by B. J. Hall and Co., Ltd., of Chalfont House, Westminster, and is illustrated by the accompanying engraving. It is claimed to have an accuracy of 1 per cent., while a complete test can be carried out in 35 minutes. As, however, at least 20 minutes of this time are occupied in the process of dissolving the bitumen, this period can be considerably reduced when several tests are taken successively.

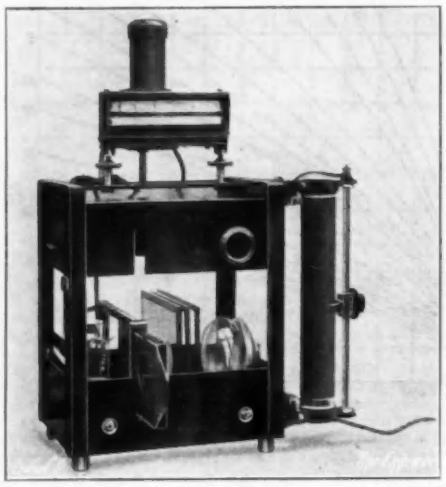
The apparatus depends fundamentally on the accurate measurement of the light transmitted through a bituminous solution. It has been proved that the weight of bitumen present in a transparent solvent definitely affects the light transmitting properties of the solution. Small changes in the weight of bitumen present create correspondingly large differences in the amount of light passing through the solution from a constant source. The control exercised by the bitumen is greatest at a definite solution concentration, and when the solution strength is approximately at this peak value, the control over transmitted light is both accurate and sensitive.

The essential features of the apparatus are an electric light, with a system of lenses, a cell or tank for the solution, a photo-electric cell, and a delicate ammeter. In the illustration, the lamp with its lenses can be seen on the right in the lower part of the instrument. It is controlled by the switch below and the rheostat shown. The solution cell is carried in a transverse slide, which is shown withdrawn for the insertion of the cell. When pushed back, the slide meets a stop to fix its position. The photo-electric cell is on the extreme left, and is hidden behind the measuring flask. Its switch is immediately below. The micro-ammeter above, it will be seen, is mounted on levelling screws and is provided with two spirit levels.

The method of operation is very simple, but must be carried out with some circumspection. The filled solution cell is slipped in place and the slide pushed in. The current for the photo-electric cell is then switched on, and, finally, that for the lamp. The lamp, however, must not be kept on for more than 10 seconds. Owing to the great intensity of the light and very considerable heat developed by the lamp, the reading taken on the scale of the micro-ammeter should be that of the initial maximum swing of the pointer. If the current is kept on long enough for the pointer to come to rest, thermionic emission may take place in the photo-cell, on account of prolonged heating by the lamp. This secondary emission gives a false reading and a steady drift of the indicating pointer will take place, making it impossible to take accurate readings. Six seconds is all that is required to read the initial swing of the pointer. The lamp should then be immediately switched off.

In view of the sensitiveness of the photo-electric cell, the slide is fitted with a catch, worked by the weight of the solution cell, which prevents it from being pushed in without a solution cell being in position to protect the photo-cell from the full light and heat of the lamp. The slide also cannot be pulled right out, and in the outer position acts as a screen between the lamp and the cell.

The scale of the micro-ammeter is generally divided in percentages of bitumen, so that direct readings can be made, but it can, of course, be divided in micro-ampères, and a conversion table be used. In order to check the calibration of the instrument three standard tinted screens



Bitumen Estimating Apparatus

are provided. They are put in the place of the solution cell and the reading checked. If necessary, any adjustment can be made by means of the rheostat.

The instrument is not confined to the examination of bitumen solutions alone, but may be used for other materials, such as oils, fats, waxes, varnishes, paints, glass, beers, wines and spirits, dyes and inks. It may also be used to detect flaws in textile fabrics and paper.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS' NEW JOURNAL.

The American Society of Civil Engineers has made a new departure. It has begun the publication of a monthly magazine, with the title of *Civil Engineering*, and it has courteously sent to us copies of the first two issues, those for October and November.

The new publication is not intended to take the place of the Society's "Proceedings," which will be continued as heretofore; but it is designed to supplement them, by dealing with such activities of the Society as lend themselves to lighter treatment than is possible in the "Proceedings" themselves. The magazine is handy to hold, measuring as it does some 9in. by 12in., and its two first numbers are exceedingly well got up and produced. Opaque paper, with a surface on which good impressions can be obtained from half-tone blocks, is employed, and a special feature is evidently to be made of the front page of the cover, which is of semi-art paper. On the front cover of the first number there is an excellent reproduction of an aerial photograph of the Hoover Dam, in the Black Canyon of the Colorado River. The contributors to the first two numbers are all of them men of high standing in various branches of the world of civil engineering in the United States of America, and the contributions, which are all most interesting, are, many of them, illustrated—some most artistically—by half-tone and line engravings.

Altogether, the two first numbers are very high-class productions, and we offer a hearty welcome to this, our latest, contemporary.

BOOSTER PUMPS FOR OIL-GAS.

In a recent issue our Canadian contemporary, *Contract Record and Engineering Review*, published a description of an interesting plant for manufacturing gas from oil and for pumping it to supplement a supply of natural gas. The installation in question has been laid down by the Union Natural Gas Company, Ltd., Windsor, Ont., and it was designed and built by the General Oil Gas Corporation, of New York City. It is a 6,000,000 cubic feet per day Dayton process oil gas installation.

The Border Cities municipalities are supplied with natural gas from the Tilbury field, which lies some 40 miles from Windsor, and to enable the Union Natural Gas Company to give better and more continuous service, it decided that it would be a good investment to install this oil gas plant to provide for emergency and peak load conditions.

Shortly after the plant was completed, it was placed in operation on very short notice to furnish gas for a severe peak load and to compensate for a break occurring in one of the supply pipe lines from the Tilbury field. The oil gas plant took up the load and operated in a most satisfactory manner, supplying the gas required until the pipe line was repaired and the demand for gas had been reduced to normal.

The plant is designed for future expansion to 12,000,000 cubic feet per day. The gas is generated in the latest type of Dayton apparatus employing Connersville auxiliary pumps. After scrubbing and cleaning with dry scrubbers, the gas is metered and stored in a 1,000,000 cubic feet three-lift gasholder. The oil is also stored in the holder tank by the use of a special oil storage ring. From the holder the gas is pumped, at 12 lb. discharge pressure, by means of two two-stage General Electric centrifugal gas boosters to the intermediate natural gas line, where the Dayton oil gas is mixed with the natural supply.

The two booster equipments each consists of two centrifugal gas boosters operating in series. The first stage machine, which is rated at FF–265–4000 cubic feet per minute, 7·4 lb. pressure, runs at 12,850 r.p.m., while the second stage is rated FF–265–3333 cubic feet per minute, 7·75 lb. pressure. These two units are driven by a double-ended 250 H.P., 1500 r.p.m. slip ring motor. The compressor fans are connected to the motor through gearing, which increases the fan speed to 12,850 r.p.m. The motor, fans and gear-boxes are all mounted on a steel base. The control for the motor is a standard drum switch, including resistances for 25 per cent. speed regulation.

To control the two motors and a number of small motor-driven auxiliaries there is a seven-panel switchboard, embodying an incoming line panel and four feeder panels, together with a blank metering panel, on which the Hydro-Electric Power Commission proposes to mount its meters for this plant. A spare feeder panel, drilled and buttoned, is also included for requirements.

THE INSTITUTION OF CIVIL ENGINEERS.

OCTOBER EXAMINATIONS, 1930: PASS LIST (*INTERIM*).

Preliminary (44).—F. Burgess, D. S. Church, J. W. Clarke, G. T. Croad, F. R. Cutler, J. M. Davies, E. Evans, A. L. Flay, R. C. R. Forsyth, R. M. Foster, J. T. Gateley, A. M. Gold, E. Grinsted, C. B. Harrison, L. A. Hatwell, R. A. Hodge, T. F. B. Holte, G. E. Horne, J. H. M. Houseago, W. J. Llewellyn, J. W. Lovatt, G. R. Lynn, G. H. Marsden, R. R. Mathews, G. J. Maylam, M. Norton-Griffiths, H. Owen, S. T. Owen, H. R. Phillpotts, J. A. Picken, G. F. Poppleton, H. N. W. Reid, E. L. Rumsey, W. Shakespeare, R. J. Siddall, E. S. Smith, F. S. Strongman, T. C. Taylor, W. A. B. Watson, R. J. L. Weber, J. V. Williams, R. K. Williams, W. R. N. G. Williams, G. V. Yorke.

Associate Membership (159).

Whole Examination: Sections A, B and C (3).—H. G. P. Burns, F. T. Davis, D. Hamilton.

Sections A and B only (8).—D. B. Booth, F. Breakwell, W. H. B. Cotton, M. R. Dharmasiriwardhane, P. J. Metcalf, K. A. Pope, R. A. Singfield, D. E. Williams.

Sections A and C only (1).—F. Margerison.

Sections B and C only (6).—G. C. B. Begg, J. R. Bottomley, W. Bowden, J. Lilly, R. A. Lyall, J. E. Sargent.

Section A only (28).—J. Beaumont, J. P. Beveridge, E. F. Boivie, P. F. Clark, J. S. Cope, D. Currie, L. H. Dickerson, R. C. Dixon, W. P. Fleming, L. M. Gardiner, E. Graham, I. O. Griffiths, N. W. Hampson, J. W. M. Hawksworth, W. C. Hayward, R. H. Hood, A. Juler, N. Lampitt, T. L. Maccabe, S. T. Monté, A. E. Motyer, C. M. Roberts, J. L. Scott, A. E. Smith, W. F. Tunks, O. J. Watt, W. L. Whately, C. V. Williams.

Section B only (31).—E. G. M. Allen, E. M. Barnard, J. Barratt, G. J. le B. Beaumont, J. M. Bett, W. Brown, C. L. Burgess, D. G. Davies, J. H. Dossett, T. Forrest, W. W. Garner, S. Green, A. E. Greig, O. Hails, G. E. Hill, B. Holroyde, W. L. Houlbrook, M. M. H. Inglis, J. D. W. Jeffery, L. E. Kent, A. J. Loveland, R. G. Murdoch, C. T. Read, E. M. Richardson, K. P. Rush, T. D. Sellman, F. W. Slade, J. Taylor, L. G. Tucker, F. Waite, J. A. Young.

Section C only (82).—J. Arrol, E. F. Ball, B.A. (Cantab.), J. E. Blair, B. Eng. (Liverpool), W. I. Bloomer, B.E. (National), G. E. V. Boldry, W. R. Branson, R. D. Brimmell, B.Sc. Eng. (Lond.), J. B. R. Brooke, W. Brundan, B. Eng. (Liverpool), A. Burrows, J. W. Caldwell, H. Caudwell, B.Sc. Eng. (Lond.), R. D. Chalcraft, C. L. Champion, B.Sc. Eng. (Lond.), F. W. G. Clifton, B.Sc. Eng. (Lond.), A. Cole, J. V. Cook, T. Cooper, R. M. Crichton, E. D. Davies, B.Sc. (Wales), T. G. Dewhurst, G. M. Dingwall, V. A. C. Durand, B.Sc. Eng. (Lond.), T. C. Durley, B.A. (Cantab.), K. Fraser, E. W. Gain, B.Sc. Eng. (Lond.), T. A. Garland, P. C. Girdlestone, B.A. (Oxon.), F. J. Grevatt, G. L. Hargreaves, B.Sc. (Belfast), R. C. Harvey, B.Sc. Eng. (Lond.), H. C. P. Havers, B.A. (Cantab.), H. O. R. Hindley, B.A. (Cantab.), T. L. Hogan, B.E. (National), G. V. Kibblewhite, B.Sc. Eng. (Lond.), G. O. Kollien, B.Sc. (Edin.), R. Kumaranayagam, B.Sc. Eng. (Lond.), H. G. Lakeman, B.Sc. Eng. (Lond.), J. E. Lee, D. H. Little, B.Sc. Eng. (Lond.), C. J. Macdonald, B.Sc. (Manchester), A. G. McLellan, B.Sc. (Manchester), J. D. Malcolm, J. Malone, B.Sc. (Glas.), T. S. Malpas, B.Sc. (Birmingham), C. F. Marshall, B.Sc. (Edin.), J. C. Martin, E. O. Measor, B.Sc. Eng. (Lond.), H. J. Miller, H. D. Morgan, B.Sc. Eng. (Lond.), A. Morton, B.Sc. (Glas.), P. D. N. Murphy, B.Sc. Eng. (Lond.), K. Nankivell, B.Sc. Eng. (Lond.), C. Needham, A. W. Nethercott, B.Sc. (Bristol), C. W. Odling-Smee, B.Sc. Eng. (Lond.), J. R. H. Otter, B.Sc. Eng. (Lond.), W. T. Owen, B.Sc. Eng. (Lond.), J. Paris, B.Sc. (Edin.), A. J. P. Pashler, G. M. Pickard, C. N. Rees, B.Sc. Eng. (Lond.), D. A. G. Reid, B.Sc. (Glas.), J. S. Robson, J. Semple, H. J. Sharp, B.Sc. Eng. (Lond.), M. T. Shaw, B.Sc. Eng. (Lond.), A. H. T. Shields, F. K. Sinclair, J. M. Smith, E. L. Snell, G. W. Spencer, H. V. Steggles, N. H. Stockley, I. D. Taverner, B.E. (N.Z.), F. D. Taylor, A. Tims, A. H. Toms, B.Sc. Eng. (Lond.), L. R. Walklin, B.Sc. Eng. (Lond.), N. White, B.Sc. Eng. (Lond.), R. W. C. Yeo, B.A. (Cantab.), O. C. Young, B.Sc. Eng. (Lond.).

The results of the examinations held abroad will be announced later.

The Junior Institution of Engineers.—At the 49th Annual General Meeting of the Junior Institution of Engineers, held on November 14th, the following election of officers took place:—As Chairman, Edwin D. Gill, F.C.I.S.; as Vice-chairmen, J. Foster Petree, A.M.I. Mech. E., A.M.I.N.A., and H. P. Wright; as Honorary Editor, C. E. Atkinson, A.M.I.E.E.; as Honorary Treasurer, W. M. Hurrell; Honorary Librarian, L. H. Ardley; Senior Councillors, A. E. Bingham, E. G. Stone and F. G. Pasotti, M. Soc. Glas. Tech.; Junior Councillor, Peter Drummond; Honorary Auditors, G. V. Rickards, J. W Stenson, T. B. Elliott-Moore and W. H. G. Churchill.

Railway and Road Matters.

THE issue by the London and North-Eastern Railway Company of £3,000,000 4½ per cent. debenture stock contained, for the first time in railway debenture stock, provision for a cumulative sinking fund for the redemption of the stock at par within forty years.

IT is reported that the Great Western Railway Company proposes to proceed at once with the purchase of 152 new motor vehicles and tractors to the value of £89,786, for use in connection with its freight services. The vehicles will be used in connection with new cartage developments.

THE Wirral Society—a body in the Wirral Peninsula which is affiliated to the Council for the Preservation of Rural England—desires it to be known that on the attention of the London and North-Eastern Railway Company being drawn to two hoardings at Bidston and Upton stations, which were considered an eyesore, they were at once removed.

THE question of the proposed tube railway from Liverpool-street to Ilford was the subject of an answer by Mr. Morrison in the House of Commons on November 5th. The Minister said that he had been informed by the London and North-Eastern Railway Company that a report had been received from the firm of engineers appointed to investigate the matter and it was then under consideration. The railway company added that, at that stage, no further announcement could be made.

THE Ministry of Transport has appointed Lieut.-Colonel Ernest Woodhouse to be an Assistant Inspecting Officer of Railways. Colonel Woodhouse received his commission in the Royal Engineers in 1903 and has been identified with railways nearly all the time since he assisted in the construction of the Woolmer Instructional Military Railway at Longmoor in 1906–07. He was in command of the 8th (Railway) Company, R.E., when war broke out and took it to France in August, 1914. From August, 1916, to May, 1921, Colonel Woodhouse was Deputy Assistant Director and, later, Assistant Director of Railways in the Transportation Branch of the War Office.

IN proposing the toast of the evening at the annual dinner of the Institution of Railway Signal and Telegraph Engineers on the evening of Thursday, November 13th, Mr. A. F. Bound, the signal and telegraph engineer of the London, Midland and Scottish Railway, said that it had recently been his privilege to visit America and, in conversation with many well-known signal engineers, to see how that country was tackling problems, many of which were problems here. One thing was immediately plain, and that was that America was free from one of our greatest drawbacks. American signalling was free from tradition; here we had let it obscure our vision so that we could not see our problems clearly. That attitude must be abandoned.

WRITING in *The Times* of November 12th, on the subject of Colonel Trench's report on the Euston buffer stop collision of September 1st—noted on page 547 of THE ENGINEER of November 14th—Mr. Dendy Marshall asks why, in these days when every cheap little motor car has a reliable speedometer, these fittings are not applied to every express engine as a matter of course. Mr. Marshall adds that, if illuminated, they would be especially valuable in the dark, when it is extremely difficult, even for the most experienced, to judge speed. In this connection we would observe that in some countries on the Continent, *e.g.*, France, speed recorders are compulsory and they have the advantage of recording the lengths of any stops made and of distant signals passed in the "warning" position.

A MEETING took place on November 7th between representatives of the railway companies and of the three railway trade unions, when each side presented its proposals, which, presumably, will later be subject to discussions between them and go then to the Wages Board. In the likely event of non-agreement at these meetings the matter will pass to the National Wages Board, which has an independent chairman and includes four representatives from the users of railways. As it has been stated in the Press that the companies' proposals are very drastic, it is only fair to say that the National Union of Railwaymen demand a minimum wage of £3 per week for adult workers, with corresponding increases in the junior rates; an eight-hour day and forty-eight-hour week—forty-seven hours for shopmen—for all employes; twelve days' holiday with pay for all employes.

IN a leading article in THE ENGINEER of October 31st on the subject of "Railway Accidents" we mentioned that, without waiting for the report of the Automatic Train Control Committee, the Great Western Company was extending its own system of automatic train control over the greater part of its main line at a cost of a quarter of a million. We mentioned also that this action might lead to the impression that the company feared collisions from signals being passed at "danger," whereas the real reason probably was that trains would then run with greater regularity in fog and that fogmen could be dispensed with. Interest in this view of the Great Western announcement is added to by the inclusion of expenditure on automatic train control on the Great Western in the Ministry of Transport statement as work for which the Government was giving assistance.

THE death, on November 8th, of Mr. Sidney P. Wood removes not only a railway signal engineer of the highest repute all over the world, but one who assisted to a successful issue the rationalisation of railway signal manufacturing firms long before that means of economy had become so popular. Mr. Wood was associated with Messrs. McKenzie and Holland, of Worcester, and after working twenty years for that firm in Australia was made a director and returned to England in the early years of the present century and became prominent in the development of automatic signalling and the operation of points and signals by power. In that connection the firm of McKenzie, Holland and Westinghouse Power Signal Company was formed, and later there came the present consolidation of the Westinghouse Brake and Saxby Signal Company. Co-operation between many signalling interests was also obtained by Mr. Wood also being the chairman of the Railway Signal Company, the Consolidated Signal Company, and the W. R. Sykes Interlocking Signal Company.

Notes and Memoranda.

A RICH seam of white barytes, said to be purer and finer than any other in Europe, has been discovered in Force Crag, at the top of Coledale Valley, between Causey Pike and Grisedale Pike, to the left of the Whinlatter Pass, Cumberland.

THE Ford Company, of America, is installing a vertical steam turbo-generator, which is said to be a record in several directions. It will be of 110,000 kW, and will work with steam at 1200 lb. pressure. It will occupy approximately the same space as two existing 12,500-kW machines, which it will replace.

ACCORDING to Mr. G. A. Plummer, who recently read a paper on the progress and development of modern steam generators before the London Local Technical Group of the Electrical Power Engineers' Association, the increased thermal efficiency obtained with pulverised fuel fired plant was probably 1 or 2 per cent., but that was offset by the increase of 2 or 3 per cent. in the power required for driving auxiliaries.

SOME experiments have been carried out by the U.S. Bureau of Standards on the merits of rubber vulcanised by means of trinitrobenzine, in the place of sulphur, for electrical purposes. The compound consisted of rubber and zinc oxide in equal parts, with 1 per cent. of trinitrobenzine, vulcanised at 141 deg. Cent. for sixty minutes. It was found that the material had no tarnishing effect on bare copper, and that its insulating qualities were little less than sulphur-vulcanised rubber.

IN the course of Technical Publication No. 355 of the American Institute of Mining and Metallurgical Engineers, Mr. F. W. Bremmer remarks that the production of oil from the deeper wells of to-day requires a casing material which is capable of resisting high stresses. The requirements for satisfactory deep-well casing are briefly discussed. Six types of steels were studied to determine their suitability for service in casing deep wells. This study indicated that one type, silicon-manganese-chrome, offered a solution to the problem. The characteristics of commercial casing made from SiMnCr steel were thoroughly studied. Tables of physical properties revealing the desirable combination of high strength with good ductility and toughness are given for the SiMnCr type casing. The development of a flattening test, performed on every piece of casing produced to insure satisfactory ductility, is also described.

ALTHOUGH the first electric cooker to be installed at Bulawayo, Southern Rhodesia, was only put in two years ago, according to the *Electrician*, there are now 315 cookers and 183 water heaters, as well as numerous refrigerators and radiators in use in that town, which has a white population of less than 9000. An electrical exhibition was held last month during the agricultural show. This feature of show week was initiated last year by the municipal authorities and has proved very successful. The Mayor, Councillor W. H. Peard, when declaring the exhibition open, said that early in 1928 the average demand on the municipal undertaking for household purposes was about 70,000 units monthly; to-day it was 250,000 units. That rapid rise had necessitated considerable extensions to the power station as well as an almost complete renewal of the distribution system. It was the policy of the Town Council, Councillor Peard added, to encourage in every possible way the use of electricity in the home.

THE report of the Atmospheric Pollution Committee of the Department of Scientific and Industrial Research for the year ending March, 1929, shows that of the principal towns of Great Britain at which observations of the dust particles which fall to the ground from the air in a month are made, only a few have districts in which the deposit is less than 12·7 tons per square mile per month. These are Bournville and West Heath, Birmingham; Garston, Watford; Headingley, Leeds; Western Park, Leicester; Rothamsted; Hesketh Park, Southport; and Clarence Park, Wakefield. The great majority of the stations—for example, London (including Kew), Cardiff, Edinburgh, Glasgow, Rochdale, Stoke-on-Trent, and the central parts of Leeds, Leicester, Birmingham, and Wakefield—have deposits from one to three times; Liverpool, St. Helens, and the centre of Rochdale have from three to five times; while City-road, Newcastle-on-Tyne, has more than five times the above. The average amount of suspended sooty impurity in the air of, for example, London or Stoke-on-Trent on a winter day, is about half a milligramme per cubic metre, domestic smoke being 2·5 times as much as industrial smoke in London and 3·5 in Glasgow, while towns like Leeds get about 25 per cent. more sunshine in the outskirts than in the centre.

AT a recent meeting of the Birmingham and District Section of the Institution of the Rubber Industry, Mr. J. Wright, of the Dunlop Wheel and Rim Company, of Coventry, dealt with the development of the wheel from the earliest examples of the device to its present form as applied to cars and aeroplanes. Particular reference was made to the problem of weight reduction, which seemed to have troubled the earliest designers as much as those of the present day. The introduction of the motor car increased the problem of the wheel designer, and the necessity of providing some means for facilitating tire changing led first of all to detachable flange devices and afterwards to the demountable rim and the detachable wheel. The former device had been extremely popular in America, though development in this country had been more on the lines of the latter. The author dealt with the reasons for that and the comparative merits of the two types. More recent developments were the wire wheel and the well base, or drop centre rim, both of which were now extremely popular in this country. There was also a rapidly growing tendency for them to replace in the U.S.A. the wooden artillery wheel and the flat base demountable rim respectively. Methods of testing wheels were referred to, and an impact machine for testing lateral strength, a torsion test machine, for testing ability to withstand driving and braking strains, and a kerb action machine for testing the effect of prolonged lateral thrusts on a revolving wheel were described.

Miscellanea.

IT is proposed to initiate aerial services from Canton to Wuchow, Swatow and Hainan.

RADIO stations are to be erected at Kweiyang, Pichiehh sien and Tungjen, in Kweichow, China.

IT is announced that a very rich deposit of pyrites has been discovered at Tolga, near Rorcs, Norway.

The Bilbertson alloy works at Pontardawe, Swansea Valley, have restarted work after having been idle since April.

IT is claimed that two Wild-Barfield electric furnaces, each of 7 tons capacity, which are now being constructed, will be the largest of their kind in England.

THE output of molybdenite in Canada last year amounted to 16,150 lb., and was valued at 6400 dollars. It required 2900 tons of ore to produce that amount of concentrate.

A FERTILISER-MIXING plant is to be put up at Charlottetown, Prince Edward Island. It is proposed to import the ingredients and, as a consequence, the facilities of the harbour are to be improved.

MEXICO'S highest powered broadcasting station has begun operations on a wavelength of 385 m. The station is situated in Mexico City, and employs the call sign XEW. Actually the wavelength is shared by CKY, Winnipeg, and by a number of low-power American stations, but no interference has been reported.

THE plant for the new steel works of the South African Steel and Iron Industrial Corporation, Ltd., at Pretoria, will be supplied almost entirely by British firms. The contract for the steel melting shop and the rolling mills has been secured by Dorman, Long, but the German firm of Demag will probably supply one of the steel furnaces and two rolling mills as sub-contractors. The blast-furnace plant has been ordered from Ashmore, Benson, Pease and Co., and the coking ovens from Woodhall, Duckham and Co.

RECENTLY, says the *Far Eastern Review*, the new coal pier for the South Manchuria Railway Company, at Kanchingtsu, across the bay from Dairen, was completed and brought into operation, and ships have been loading cargoes since about the middle of July. The officials in charge of operations estimate that about 3,800,000 tons of coal will be exported from Kanchingtsu annually. Most of it will go to Japan, China and the East Indies. Four ships, each of 8000 tons capacity, can be accommodated at one time, and the depth of water at low tide is 30ft. The coal, mostly bituminous, comes from the Fushun mines of the South Manchuria Railway Company. Now that the new coal pier is ready for operations, all the coal heretofore carried to Dairen for export will be brought to Kanchingtsu. A large coal yard, already completed, is about three-quarters of a mile from the pier, and can accommodate about 3,000,000 tons of coal.

IT is announced from Madrid that the Spanish Government has decided to provide five new lighthouses and four small light-stations for the better guidance of ships along the Spanish Moroccan coastline, and that several British firms are understood to be submitting tenders for their construction. The lighthouses are to be of the automatic type, switching on at sunset and off at sunrise. The illuminant is to be acetylene gas, and each lighthouse must have a plant capable of producing a three months' supply without attendance. The points at which these lighthouses are to be erected are: Punta Santiago, where the tower is to be 54ft. high and the light visible for 20 miles; Punta Hermosa, with a 48ft. high light, visible for 15 miles; Punta Sagre, another 54ft. light with 20-mile visibility; Islote Toringa, 48ft. high, light visible for 20 miles, and 12ft. high light for Loro, Fernando Po. Smaller fixed lights are to be placed at Corisco, Elobrey and Ivelo, where two lights, a "front light" and a "back light," are to act as directing signs in the river estuary.

WE hear that an expenditure of over £50,000 is to be undertaken by the London, Midland and Scottish Railway Company in the development of Ayr Harbour in accordance with the terms of the Ayr Harbour Transfer Act of 1919. In compliance with the obligations under that Act, the railway company has already expended between £3000 and £4000. The new work now sanctioned by the board of the company, according to intimation made to the Town Council recently, includes the replacement of existing cranes with modern appliances of greater efficiency and increased capacity. For the shipment of coal electrical belt conveyors, with tippers, capstans and weighing machines, capable of dealing with 20-ton wagons, are to be provided—one fixed conveyor at the river berth, and one fixed and one travelling conveyor at the tidal dock. For general traffic three 3-ton and one 5-ton electrical cranes are to be erected. Provision will also be made for additional siding accommodation to the extent of 470 wagons, and additional loop lines will be constructed to facilitate the working of the traffic of the harbour.

A REPORT from Athens states that, on the initiative of the Greek League of Manufacturers, the proprietors of the Greek ironworks recently held a meeting at the headquarters of the Hellenic Iron Industry Union, Hephaistos, at which the question of reorganising the whole of the Greek iron industry and building large up-to-date shipyards at the port of Piræus and repair yards for shipping was discussed. It was decided to form a big joint stock company at the Piræus, in which all the ironworks and existing smaller shipyards will participate. It is suggested that the new company, which would be supplied with capital by Greek financiers and shipowners, should build big shipyards at the Piræus and at Salonika. The proposal also provides for the carrying out of repairs and the construction of big vessels for passenger and goods traffic, as well as of warships. It is anticipated that in view of their being equipped, as it is proposed they should be, with really modern technical plant, the shipyards would be able to compete very keenly with all the other yards at Mediterranean ports as regards both conditions and speed of production. The company will also control an ironworks and foundry. The engineering works already existing in Greece will change over to the manufacture of machinery and apparatus previously imported from abroad.

NEW OPENING-SPAN BRIDGE AT GREAT YARMOUTH

MESSRS. COODE, WILSON, MITCHELL AND VAUGHAN-LEE, MM. INST. C.E., WESTMINSTER, ENGINEERS

(*For description see page 558.*)

THE BRIDGE CLOSED FOR TRAFFIC

THE BRIDGE WITH LEAVES RAISED

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Contents.

THE ENGINEER, November 21st, 1930.

	PAGE
A SEVEN-DAY JOURNAL	557
NEW BASCULE BRIDGE AT GREAT YARMOUTH. (Illus.)	558
SIDE WIND AND THE RESISTANCE OF TRAINS	560
WIRELESS DEVELOPMENTS IN CANADA. (Illus.)	561
LETTERS TO THE EDITOR—	
Sags and Stresses in Overhead Wires	563
Power from Warm Water	564
Engineering Aid to Industry	564
Technological Unemployment	564
REPORT ON THE ULTRA-VIOLET TRANSMISSION OF "VITA" GLASS	565
THE OPENING OUT OF COFTON TUNNEL, L.M. AND S. RAILWAY	565
SIXTY YEARS AGO	565
TUBES FOR HIGH-PRESSURE WATER-TUBE BOILERS. (Illus.)	566
A PHOTO-ELECTRIC BITUMEN ESTIMATING APPARATUS. (Illus.)	568
THE AMERICAN SOCIETY OF CIVIL ENGINEERS' NEW JOURNAL	568
BOOSTER PUMPS FOR OIL-GAS	568
THE INSTITUTION OF CIVIL ENGINEERS	568
RAILWAY AND ROAD MATTERS	569
NOTES AND MEMORANDA	569
MISCELLANEA	569
LEADING ARTICLES—	
Engineering in Germany—Railway Electrification in Italy	571
INSTITUTE OF MARINE ENGINEERS. No. I. (Illus.)	572
OBITUARY—	
Emile Garcke	573
THE HEATING AND DRYING OF GRANULAR MATERIALS BY CONVECTION. No. III. (Illus.)	574
THE OWENS BOILER CIRCULATOR. (Illus.)	575
POWER STATIONS ON SWEDISH RIVERS	575
A NEW AIR-COOLED MECHANICAL STOKER. (Illus.)	576
FIRING A BOILER	576
NEW TYPE OF FLOORING FOR WORKSHOPS. (Illus.)	577
SOUTH AFRICAN ENGINEERING NOTES	577
A NOVEL CASTLE NUT. (Illus.)	577
TOTALLY ENCLOSED SQUIRREL-CAGE INDUCTION MOTORS. (Illus.)	578
CANADIAN ENGINEERING NEWS	578
PROVINCIAL LETTERS—	
The Midlands and Staffordshire—Lancashire	579
Sheffield—North of England	580
Scotland—Wales and Adjoining Counties	581
LAUNCHES AND TRIAL TRIPS	581
PERSONAL AND BUSINESS ANNOUNCEMENTS	581
CURRENT PRICES FOR METALS AND FUELS	582
FRENCH ENGINEERING NOTES	583
BRITISH PATENT SPECIFICATIONS. (Illus.)	583
FORTHCOMING ENGAGEMENTS	584
CONTRACTS	584

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THE ENGINEER.

VOL. CL No. 3906

NOVEMBER 21, 1930.

Engineering in Germany.

A FACT which has disturbed many an observer is the increasing prevalence of the "inferiority complex" in British technology. It began some years ago with the intellectuals of the day, who sneered at and satirized our self-sufficiency and insularity. They challenged the vaunted superiority of Great Britain, upheld the efficiency of other countries, accused the home manufacturer of purblindness, and foretold his rapid supersession by foreign rivals. Under the growing criticism the British manufacturer began to lose confidence in himself, and, despite all the efforts, well justified and supported as they might be, of technical men, the laymen who control industry continued to decry the ability of Great Britain and to exalt that of her competitors. Our confidence, even our self-respect, was undermined, and in lieu of the faith that of old we placed in our own ability, a tendency to put our trust in the methods of foreign countries arose. The encouragement which should have been given to our people was turned into sneering, and even our own inventions were allowed to lapse until they came back to us under foreign names and supported by specious arguments which the unwary took for "Science." With confidence gone, half the battle was lost. The certainty of ultimate success was replaced by a fear that the foreigner would do still better, and, in all ranks of society, one of the characteristics which had contributed to the building up of British industry and British influence was dissipated. We began to fear to command, we lost that magnificent arrogance upon which the Empire was built up, and we allowed ourselves to acknowledge an equality, even an inferiority, with other nations.

It is to be hoped that, some day, we shall defy intellectual estimates of our relative value, once more assert that we *are* the best, and so regain that confidence in ourselves that will make us the best indeed. A little fuller knowledge of our competitors will help us towards that desirable consummation. The astute foreigner shows us of his best, and we leave him convinced that what we have seen represents a real average. We know the hinterlands of our industries; he has not allowed us to see those of his. How many people would believe that—excluding the smallest—ninety-five per cent. of the engineering firms of Germany employ less than two hundred hands each, or that the German proportion in the world production of machinery fell from 20·7 per cent. in 1913 to as little as 13·1 per cent. in 1925, when that of the other leading industrial countries had increased, or that German foreign trade has declined from 29 to 22·8 per cent., in spite of the fact that by all sorts of means she has had to force her foreign trade because the home market could consume only 60 per cent. of the output, as compared with 75 per cent. before the war? Such facts as these, which were presented by a manufacturer at the annual meeting in 1929 of the Federation of German Engineering Works, give us just cause for believing that the current opinion—carefully fostered—that German engineering is superior to British engineering is entirely without foundation. Let us take a few more figures from a report recently issued by the Department of Overseas Trade and entitled "Economic Conditions in Germany"—a report which we commend to the attention of engineers who are depressed by our own industrial conditions. The Federation above referred to states that "after carefully examining the position of over eighty representative firms of the chief groups in the machine and apparatus branches, it ascertained that on an average no profit was made" on foreign orders. That was in '29. In the present year the working time has fallen to 60 per cent. of capacity, and dismissals of staff and workpeople have taken place. We recently showed—see THE ENGINEER, October 31st, 1930—the deplorable state of the locomotive industry in Germany. In several other industries the position is as economically bad. In the case of tools, for example, though a rise in exports has, indeed, taken place, it is insufficient to compensate for the decline in home sales, and in shipbuilding the capacity of the German yards is twice as great as the work in hand or in sight.

It is good for us to look at such facts as these now and then. If the technological progress of our great continental competitor was, in reality, as far above our own as some people would have us believe, if her methods of production were so greatly in advance of British methods, if the quality of her materials and the superiority of her designs were so much better than ours, then she ought to have been able to hold on to her foreign trade much more firmly than she has done, and the depression in this country should have led to a boom there. But that is not what we find. There is no evidence that the German engineering industry is in a better state than our own, and there is evidence that when Germany does compete successfully with us in neutral markets she does it at a financial loss. Let us draw encouragement from that fact. We are not nearly as bad as we are made out to be by our own critics. Indeed, we are excellent engineers with, despite everything, a sound engineering industry. What we lack is confidence in ourselves, readiness to believe that British engineering is as good as any in the world, and a willingness to listen to and help our own inventors before we suffer the blandishments of foreigners.

Railway Electrification in Italy.

THE electrification of Italian railways, which began many years ago, has always been a matter of interest, mainly because of the adoption of the three-phase system. That the scheme has not been utilised in any other part of the world is scarcely to be wondered at, for it is well known that it involves two overhead conductors and introduces considerable complications, especially at cross-overs and junctions. In Italy all the difficulties presented by the overhead conductors have been overcome, but it is clear from a paper read by Mr. G. Bianchi before the Institution of Electrical Engineers on Thursday, November 20th, that for some time past the disadvantages of low-frequency three-phase working, at any rate, have long been recognised. In 1905 the principal railways were taken over by the State and between 1910 and 1916 some 230 miles were electrified on the three-phase system at 16⅔ cycles, a scheme which not only involves two overhead conductors, but also special generating plant for producing current at the low frequency. At a later date, however, other lines were electrified on the three-phase system at the industrial frequency of 45 cycles and on the 3000-volt D.C. system. Both schemes naturally avoid the use of special generating plant, which is a very distinct advantage, whilst the D.C. system only calls for one overhead wire. There are probably few engineers outside Italy who would tolerate the complications of the three-phase

overhead equipment, but apparently the system still has its advocates in Italian engineering circles.

The experience gained since 1920 has enabled many important conclusions to be arrived at, and the question of carrying out further electrification on the three-phase system has been warmly debated. Although there has been much diversity of opinion on the matter, it is now generally recognised that in order to utilise the hydraulic power of Italy to the best advantage, the electric current used for traction should be of the same frequency as that of the current supplied for industrial purposes, and that it should be possible to employ the same transmission lines in both cases. These conclusions are undoubtedly sound, and the only question that remains is whether the trains on lines that are not at present electrified should be supplied with three-phase A.C. or high-pressure D.C. The three-phase system at industrial frequency is now being tested on the Rome–Sulmona line, whilst the 3000-volt D.C. system has been adopted on the Benevento–Foggia line, which has been in operation for more than three years. The latter system removes both the drawbacks mentioned, but Italy is now faced with the fact that it has three systems of electrification—low and industrial frequency, three-phase, and high-pressure direct current. When in 1919 the tests on the two new systems were decided upon, many engineers naturally pointed to the difficulties that would arise from the fact that it would be impossible for the locomotives belonging to one system to run on the lines of another system, and it was therefore decided that each system should be limited to its own zone. No attempt is to be made in Italy to standardise railway electrification, as in this country and elsewhere. In Northern Italy the original three-phase, 16-cycle system is to be continued; whilst in the event of the three-phase industrial frequency system proving satisfactory, it will be adopted in Central Italy, and the high-pressure D.C. system in Southern Italy. The conditions in Italy will therefore leave much to be desired, but it is to be remembered that railway electrification in that country dates back many years, and that the cost of standardisation at this juncture would probably be very great, not to mention the difficulties involved. The difficulty of deciding what system to adopt has no doubt retarded progress in the past. The diversity of opinion of experts and the possibility of improved methods of electrification have always been obstacles, but in the very early days of electric traction Italian engineers made use of a system which at the time appeared to be the most desirable, and it is not surprising that other systems are now proving better. The fact that Italy now has three systems in use is unfortunate, but it is worthy of note that locomotives equipped for 10,000 volts and industrial frequency can be run at about one-third of their normal speed on branches electrified on the 3700-volt, 16-cycle system. The possibility of running D.C. locomotives on the three-phase lines has not as yet been completely investigated, although it is clear that the only possible method of doing so is to provide the D.C. engines with converting or rectifying plant and suitable current collectors.

The desirability of adopting a standard system of electrification has been recognised in most countries. Some have adopted the single-phase A.C. system, others the D.C. system; but, in our opinion, all existing systems leave something to be desired. The single-phase system calls for special generating plant or frequency changers; the three-phase system for two overhead wires; and the D.C. system, which, incidentally, is limited to a distribution pressure of about 3000 volts, converting or rectifying plant. Since the introduction of the mercury arc rectifier, which is more efficient than the motor generators used in the past, some engineers seem to consider that the problem of long-distance railway electrification has been completely solved. But whilst it is true that the rectifier has simplified the process of providing the high-pressure current, 3000-volt locomotives are somewhat costly, and it is yet to be proved that a pressure of 3000 volts is always the most economical pressure. The scheme that has long seemed to us to be well worthy of careful consideration is that described in our issue of December 5th, 1924, and which is to be put into operation in Hungary. In accordance with the scheme, single-phase current derived from the ordinary industrial 50-cycle, three-phase supply system, is supplied to the locomotives at any desired pressure, and is converted into three-phase current. The locomotives are said to be costly, but, on the other hand, the scheme calls for no converting sub-stations. It imposes no limitations on the working pressure, and it only calls for one overhead wire. The problem of balancing the load on the three phases of the industrial system does not appear to be worrying those responsible for the scheme, which will shortly be put to the test of practical application. Most countries, however, have now settled on one of the alternative schemes, and even if the new method proves satisfactory in Hungary, it is improbable that it will be adopted very widely elsewhere.

Institute of Marine Engineers.

TUBES FOR HIGH-PRESSURE WATER-TUBE BOILERS.

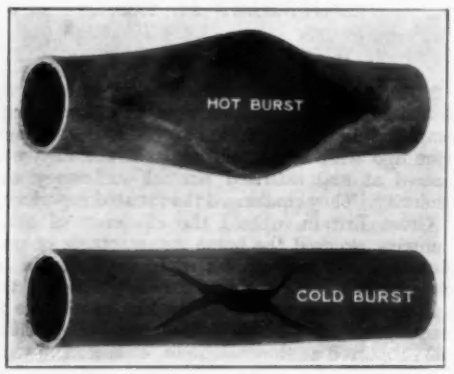
No. I.

THERE was a large and representative attendance of members and visitors at the meeting of the Institute of Marine Engineers held on Tuesday, November 11th, when Mr. S. F. Dorey, of Lloyd's Register of Shipping, read his paper on "Tubes for High-pressure Water-tube Boilers," the first two sections of which we reprint, in an abridged form, on page 566. In what follows we give the substance of the discussion, which was valuable as representing the views not only of steel makers and tube makers, but also the designers and builders of high-pressure boilers of the type dealt with.

Mr. W. W. Marriner, of Yarrow and Co., Ltd., considered that it was impossible to over-estimate the importance of Mr. Dorey's paper, which had been presented at a most opportune time, when we were looking for a lead from the great classification societies as to their requirements for boiler tubes.

The existing rule for calculating the thickness of the tubes for a water-tube boiler was based on a stress in the material of the fire rows of about 1¼ tons per square inch. For pressures up to 250 lb., that gave results which allowed a large margin of safety and provided not only for corrosion, but for the other stresses which a tube is called upon to withstand. But at pressures above 400 lb. per square inch, a rule based on this low stress allowed a margin which appeared excessive, so that for such pressures a revision of the rule seemed to be necessary. The solution of the problem as given by Mr. Dorey was based on a complete scientific investigation, and he gave simple formulæ which met the various conditions in a practical way.

A few years ago Yarrow and Co. made a series of



CHARACTERISTIC TUBE BURSTS

experiments to find out at what pressure a tube would burst. They took an ordinary boiler tube, 1¾in. outside diameter, 0·212in. thick. First, a longitudinal slot was cut in the metal, thus thinning the tubes down to various thicknesses at the bottom of the slot, and hydraulic pressure was then applied to burst the tube. The bursting pressure was about 1400 lb, per $^{1}/_{64}$in. thickness of metal left at bottom of slot. Secondly, the tube was thinned down over a length of 6in. to various thicknesses and again burst by hydraulic pressure. A tube thinned down to $^{1}/_{64}$in. thick burst at 1100 lb. water pressure. Thirdly, as the results of the above experiments always showed a very small rupture, because the hydraulic pressure was released immediately the fracture occurred, some tubes were tested under steam pressure, so as to get the result of the explosive force of the steam, and Messrs. Yarrow found that it took a pressure of 1250 lb. per square inch to burst a 1·33in. diameter tube, the walls of which were 0·017in. thick. Fourthly, a tube in which there was a steady steam pressure of 375 lb., was heated in a furnace, and it was necessary to make the tube almost white hot—2000 deg. Fah., as measured by a radiation thermo-couple—before it was possible to rupture an ordinary 1¾in. tube, the walls of which were 0·128in. thick. Fifthly, a tube 1¾in. diameter, thickness 0·128in., was burst with a hydraulic pressure of 8000 lb. per square inch. This tube expanded from 1·759in. diameter to 1·984in. diameter before bursting. Photographs of these tubes showing the characteristics of the bursts are reproduced above. It was very difficult to form a reliable estimate of the amount of work done by the various rows of tubes in a boiler. With the help of Dr. Muir, of the Royal Technical College, Glasgow, Yarrow and Co. had made many investigations on this question of heat transmission, and, as far as present knowledge went, the following figures were suggested.

In an ordinary boiler evaporating 6 lb. to 8 lb. of steam per sq. ft. of heating surface per hour, the heat transfer in the fire rows was something between 40,000 to 60,000 B.Th.U. per hour and the heat transfer in the outer rows of tubes was something between 1000 to 3000 B.Th.U. per hour. In a destroyer boiler at full power evaporating 16 lb. to 18 lb. of steam per square foot of generating surface, the heat transfer in the fire rows was something between 100,000 to 120,000 B.Th.U. per hour, and the heat transfer in the outer rows was something between 2000 to 8000 B.Th.U. The relation between the heat transfer in the fire rows and in the outer rows of any nest of tubes was dependent on many conditions, amongst them being the number of tubes in the path of the gases, the temperature of the pre-heated air supply to the furnace, and the percentage of CO_2 in the flue gases.

It would be interesting to hear Mr. Dorey's opinion as to the nature of the failure which would take place if a boiler tube were made too thick for the corresponding pressure and rating. One might imagine that the tube would swell and become thinner, thereby correcting the original mistake of making the tube too thick, but Messrs. Yarrow had had no evidence of that compromise being arrived at in practice, and one would hesitate to leave tubes in a boiler which showed signs of swelling, although, perhaps, the swollen tubes might be safer than the original tubes. One question arose as regarded the stress due to rating and temperature, namely, did a high stress increase the liability to corrosion?

The question of creep over a long period had been fully brought out in Mr. Dorey's paper. There was, however, another effect of high temperature, namely, that of annealing the material, which, even if it lasted for only a short period, ought to be avoided, and one desirable property of a tube was that of having a high annealing temperature. The tightness of superheater joints generally depended on the internal stress in the material, and if the material was raised above a certain temperature, that internal stress was relieved. If, therefore, a superheater tube which had been expanded into a tube plate was at any time raised to that annealing temperature in the tube plate, the joint between the tube and the tube plate would not remain tight. There were ways of getting over that difficulty, viz., by welding the tube into a flange or header, but even in those partly welded constructions, the tightness of the joints at some place would depend on the internal stress which had been produced in a bolt or stud by the act of screwing it up, and in that case also, if at any time the temperature should rise much above the designed temperature, the joint would fail.

Mr. Dorey had drawn attention to the blow-pipe action of the flames. In all boilers which were fitted with baffles near the fire, whether those baffles were formed of refractory screens or by bending the tubes so that they lay close together, there was a probability that the portions of the tubes where the baffles ended would be exposed to a blow-pipe action. That effect was due to the concentration and, consequently, high velocities of the gases at such points in their endeavour to travel by the shortest path.

The speaker referred again to the importance of the paper, and expressed the hope that the Institute would draw the attention of the Board of Trade and the registration societies to the facts brought forward by Mr. Dorey, so that rules might be drawn up to meet the requirements of up-to-date British practice.

Mr. C. Humphrey Davy, of Babcock and Wilcox, Ltd., remarked that one of the biggest difficulties in connection with tube wall thickness was the ascertaining of the actual internal and external wall temperature of the tube. The uncertainty with regard to temperature, and particularly external temperature, of tube walls compelled the designer to rely on empirical formulæ, based on observation and long experience. If a low-pressure tube thickness were determined only from the point of view of stress, it was doubtful whether there would be sufficient wall thickness to provide for a satisfactory expanded joint. Furthermore, the corrosion factor became far more important in the case of low-pressure boilers, because pitting of a thin tube wall naturally resulted in a far greater percentage reduction in the strength of the tube than would be the case with a thick-wall high-pressure tube. On the other hand, when dealing with thick tubes for high pressures, the questions of possibility of expanding, ratio of internal diameter to length, and stresses set up in the internal wall of the tube became of greater importance than the mere bursting stress in the tube itself.

Under the heading of tube materials, Mr. Dorey had given a good deal of food for thought. The suggested specification of a maximum percentage of sulphur or phosphorus of 0·035 and 0·03 respectively, whilst ideal, might prove rather difficult to work to in practice as a certain amount of margin was naturally desired by the maker of the tube steel, and from a practical point of view a maximum content of 0·04 per cent. in each case was considered to be very good practice. The figure of the British Engi-

neering Standards Association was 0·05 per cent., and that specification formed the basis for the majority of requirements in this country at the present day. Those remarks naturally applied to mild steel only, as special alloy steels naturally required different specifications. In this country one of the best-known specifications for tube material gave only a maximum tensility of the tube billet, that being 28 tons per square inch, and it was common practice to call for tensile tests on the tube material only, seeing that the satisfactory condition of the tubes themselves could best be checked by expanding, flattening and crushing tests.

In the majority of cases the tubes for water-tube boilers were expanded into tube plates having a tensility of 28 to 32 tons, or into sectional headers manufactured from billets having a tensility of 26 to 30 tons, and since, in boilermaking, it was desirable to retain a margin of at least a ton between the tensility of the tube and the tensility of the plate into which it was expanded, it would appear that in some cases a rather lower maximum tensility for the tube billet would be desirable. In most cases the matter was automatically regulated by the tube maker, who, having no minimum tensile limit specified, naturally chose a good ductile steel which, in the majority of cases, gave a finished tube having a tensility of between 23 and 25 tons per square inch. Those tubes gave a very satisfactory expanded joint, and it would appear, therefore, that a maximum tensility rather lower than that at present specified would safeguard the position.

Some interesting remarks had been made by Mr. Dorey on the possibility of using steels having a higher carbon content than that which has been widely used at the present day, namely, about 0·1 per cent. to 0·15 per cent. carbon content. Such steels had already been tested to some extent, but they had not up to the present proved very satisfactory, and there was a good deal of information available to show that steels having carbon contents ranging from, say, 0·2 to 0·4 per cent., were very much more subject to the effect of creep than lower carbon steels, owing, presumably, to the spheroidisation of the carbide in the crystal structure. In addition, the experiments which the speaker's firm had carried out in a special experimental superheater over a period of 18 months showed that increase in carbon percentage gave rise to very rapid oxidisation of the internal surface of the tubes, and their experience was that tube failure due to internal oxidisation was of almost greater moment than failure due to low creep values at high temperatures. In many cases tubes had been found to contain several layers of oxide on their internal surfaces, showing that the first oxide scale formed was not a definite protection against further oxidisation as had often been thought.

Reference had been made to an alloy steel known as "Enduro," in which the chromium and nickel contents were given as 16·7 and 0·19 per cent. respectively. It might be of interest to know that the original "Enduro," which was known as "Enduro Metal A," had been entirely superseded by what was known as "Enduro S. 188," in which the percentages of chromium and nickel were increased to 18 and 8 per cent. respectively. The special superheater working at a steam temperature of 1000 deg. Fah., which was installed experimentally at the Delray Station of the Detroit Edison Company in America, was manufactured from that "Enduro S. 188," and the condition of the material was being very carefully watched by the Babcock Company, of New York, which was responsible for the design and manufacture of the superheater.

Dr. J. W. Jenkin, the director of research of Tube Investments, Ltd., said that Mr. Dorey's paper was of especial value when read in conjunction with a paper presented to the North-Western Branch of the Institution of Mechanical Engineers the previous Thursday by Mr. K. Baumann. He thought that both authors rightly emphasised the importance of creep as a basis of design, and that Mr. Marriner's point about the loosening of expanded joints was similar to the loosening of flange bolts dealt with by Mr. Baumann, and attributable to relief of stresses by creep, as distinct from a function of annealing temperature. The author's call for soundness of steel and reliability against segregation was already well met by the fact that a large percentage of tubes were now made from fully killed steel, and sulphur printing of billets had been standard practice for years. While non-segregated steels gave better service from the corrosion point of view, the uniform distribution of inclusions involved grave risk of external fissures on roller expanding. Mr. Dorey did them a service in emphasising the importance of resistance to oxidation, but it was difficult to gain that end by the use of alloy steels without affecting the mechanical properties. It would be more logical, he thought, to modify the specification for mechanical tests in the cold, provided a scale-resisting material which would expand and bend satisfactorily was available. Austenitic steels, apart from their high cost, required nursing in tube manufacture and involved a special technique. If, for present practice, they could afford to neglect oxidation, the copper-molybdenum and molybdenum steels to which the author referred offered a promising field. The tendency to increase temperatures would, however, demand a non-scaling material for tubes. It was difficult to follow the author's suggestion that a satisfactory annealing of the tubes subsequent to manufacture would retard the effect of spheroidisation of the cementite on the rate of creep, since the normalising treatment after the last pass, now current practice, was the only way to postpone the conversion of the carbide into globular form. Experience indicated that the majority of tube failures were due to faulty working conditions.

Mr. F. S. Marsh, of the Chesterfield Tube Company, referring to the author's remark as to the general use of mild steel tubes, on account of their relative cheapness and ease of manufacture, pointed out that many kinds of special steel were now available for tube making. The qualities possessed by such steels could not, however, be obtained without a proportionate expense. As regarded Mr. Dorey's suggestion that the sulphur and phosphorus contents should both be limited to 0·03 per cent. in tube steel, the speaker considered the limitation to be too severe. Excellent tube-making steel was available containing sulphur and phosphorus up to 0·05 per cent. The important thing for users to insist on was uniformity of material, since want of uniformity facilitated corrosion at points of contact between different constituents. Both tube makers and steel makers were alive to the importance of that question, and users could render service by reporting on the behaviour of special materials after a certain length of service. The author had not discussed the relative merits of cold-drawn tubes and hot finished tubes, though the subject was one which gave room for discussion.

Mr. W. J. Talbot, of the Talbot-Stead Tube Company, Ltd., Walsall, expressed the opinion that some of Mr. Dorey's figures were on the safe side; for example, for 1800 lb. pressure he gave a thickness of 3-gauge. There had been working in a German locomotive under similar pressure conditions tubes of 7-gauge thickness, which suggested that Mr. Dorey's figure was on the safe side. The author's diagrams were extremely valuable. The figures given, however, would require to be checked, as he (the speaker) had been taught to be cautious in these things. Mr. Dorey's reference to alloys was absolutely up to date, but he was afraid that as regarded the manufacture of superheater tubes the makers would have to modify their methods, because the very materials which were proving to be most valuable for high temperatures with high creep values and resistance to oxidation would not machine well. The chromium-nickel-tungsten alloy to which Mr. Dorey referred was most prohibitive in cost. Incidentally, it might be mentioned that the tungsten content was generally 0·6 per cent. There was one installation in London of superheaters with tubes made of such material, which took 66 tons of steel for a beginning. It had been stated that that material was not to be considered safe. In a superheater which had been working for more than eighteen months the microphotographs taken before and after operation showed no difference in structure resulting from a temperature in the tubes which at times reached nearly 1000 deg. Cent.

With regard to sulphur prints, he had been asked by a high Admiralty official some time ago what he thought as to the value of sulphur prints. He replied that he doubted their value; that view, he understood, was shared by some Admiralty officials. Such a view was probably partly true, because the bulk of the tubes in the British Navy had been made from segregated steel. Other steels did not expand nearly as well as the segregated steel, and the outside rim of a segregated steel certainly made a better finished job.

Mr. H. E. Geer, of the Superheater Company, Ltd., said that his firm had been urging steel makers for some time to produce a steel of equal ductility to ordinary mild steel, but having superior heat-resisting properties at temperatures between 400 deg. Cent. and 500 deg. Cent. One of the English steel makers had just informed him that his firm had succeeded in producing a steel which showed creep limits of 7·5, 5·1 and 3 tons respectively at temperatures of 400 deg., 450 deg. and 500 deg. Cent. Those figures were comparable with 3·8, 2·4 and 1 tons for ordinary steel at the same temperatures. In both cases the creep limits were determined by the firm's standard quick-time method. The new steel could be forge-welded, and, therefore, it would appear, did not contain chromium. Oxidation tests were to be carried out, and, if satisfactory, it would appear that a valuable material would be available for superheater construction.

As regarded dissociation of steam, Mr. C. H. Fellows, of the Detroit Edison Company, had made experiments concerning the action of steam at pressures ranging from 100 lb. to 400 lb. per square inch on tubes maintained at a temperature of about 1200 deg. Fah. At a steam speed of 25ft. per minute, considerable corrosion took place, at 850ft. per minute the corrosion was much less, while at 3000ft. per minute no oxidation could be detected. The latter speed was quite a normal one in modern superheaters.

The practice of the speaker's firm was to insist on the lowest possible sulphur content in superheater tubes. They had recently been obtaining steel with a sulphur content not exceeding 0·02 per cent. It was a mild steel of 22 to 26 tons tensile strength, non-segregated, clean and homogeneous, and the tubes made from it were the best they had been able to obtain. In superheaters subject to both radiation and convection, much higher rates of heat transmission than 8000 B.Th.U. per square foot were common practice. A rate of 25,000 B.Th.U. was obtained in the portions of the superheaters exposed to radiation and convection in the plant of Synthetic Ammonia and Nitrates, Ltd., where steam was delivered at 750 lb. pressure and 840 deg. Fah. temperature. Low carbon steel tubing containing small percentages of copper and molybdenum, somewhat similar to that mentioned by the author as made by Messrs. Thyssen in Germany, had been supplied to the Superheater Company by the Chesterfield Tube Company. That kind of steel could be satisfactorily forge-welded to ordinary mild steels, as would be evident by the sample shown at the meeting. Hence, if its heat-resisting and creep-limit qualities were superior to those of mild steel, it would allow of the manufacture of complete superheater elements, in which the low temperature portion could be of ordinary steel and the high temperature portion of alloy steel, without having to employ separate sections with intermediate joints.

(To be continued.)

Obituary.

EMILE GARCKE.

On Friday, November 14th, Mr. Emile Garcke, for many years a prominent figure in the electrical industry, died at his home near Maidenhead, at the age of seventy-four. He was President of the British Electrical Federation and was associated directly or indirectly with many electrical companies. Beginning on the administrative side, he turned later to the financial side of the electrical business, and his enterprises in the early years of electric traction proved particularly successful. He also took an active part in framing the early legislation in connection with electricity supply in England, served on many public committees on electrical affairs, and was recently appointed a member of the South-West Midland Advisory Joint Committee, established under the South-West Midlands Electricity District Order. He took a keen interest in industrial co-partnership, as adopted by the Brush Electrical Engineering Company, Ltd. of which he was chairman.

He was born in Germany, but at an early age he came to England and became a naturalised British subject at the age of twenty-four. During his early years in this country he devoted himself to mining ventures and banking, but in 1883 he was made secretary of the Brush Electrical Engineering Company, and occupied that position for ten years. Later he because chairman and managing director; whilst in 1893 he occupied the position of managing director of the Electric Construction Company. In 1895 he formed the British Electric Traction Pioneer Company, which afterwards changed its name to the British Electric Traction Company. As managing director of that concern, he devoted himself for many years to the development of traction and electricity supply, both in this country and abroad. It was only last year that he retired from all executive work connected with this company.

The Electric and General Investment Company was established about this period by Mr. Garcke for the financing and promotion of electrical undertakings. Much of his time was devoted to electric supply and electric transport in the Midlands, and, in addition to his position on the Advisory Joint Electrical Committee, he was Chairman of the Shropshire, Worcestershire, and Staffordshire Electric Power Company, which gives a supply to a large area in the Midlands. In the metropolitan district he had similar interests, obtaining at his own cost the initial powers of the County of London Electric Supply. For over twenty years he was chairman of the North Metropolitan Electric Supply Company. Besides his service on public committees, Mr. Garcke was associated with various semi-public matters. He was, for instance, instrumental in founding the electrical section of the London Chamber of Commerce, and later became chairman of the section. He was also a member of the Executive Committee of the Federation of British Industries and a Vice-President of the Tramways and Light Railways Association. His "Manual of Electrical Undertakings," which he founded in 1896, is well known to all electrical engineers, and during his lifetime it grew from a small book of a few pages to an annual record of over 2000 pages. Apart from his work, he was mainly interested in philosophy, and was the author of a book on that subject. He was one of the founders and Hon. Treasurer of the British Institute of Philosophy.

SPEAKING on the Address in the House of Commons on November 4th, Mr. Morrison stated that the Government had undertaken to assist, to the extent of over 100 million pounds, schemes for the economic development of transport and electricity supply. From a statement since published it appears that included in these sums are 11 millions for the Metropolitan Railway and the Underground Railways and 10 millions for the main line companies.

The Heating and Drying of Granular Materials by Convection.

By W. GILBERT, Wh. Sc., M. Inst. C.E.

No. III.*

CLAY DRYING.

A LARGE number of experiments have been made on the drying of clay. A class of clay was selected, which, after soaking, would conveniently retain about 25 per cent. of moisture. By the use of wood moulds the clay was formed into cubes of ½in. side and also of 1in. side, and these cubes were dried in the copper furnace—see Fig. 6, November 7th—and on the grid of the velocity apparatus—see Figs. 1 and 2.

In order to obtain the rate of heat supply by convection during the heating of each clay cube corresponding experiments were made on copper cubes coated with lampblack. As previously noted, owing to the high conductivity of copper, the average temperature curve during heating will practically coincide with the surface temperature curve; hence the rate of heat supply by convection at any stage can be obtained from the graph.

½in. Copper Cubes in Copper Furnace. W=0.—The interior of the furnace was coated with lampblack. the six cubes used were supported on a circular grid of very fine steel wire, so that practically the whole of each cube surface was acted upon both by radiation and by convection. The furnace temperature was kept steadily at 400 deg. Fah. Owing to the mass of the copper furnace the temperature fall during the insertion of the cubes was small. After definite periods of heating the copper cubes were tipped into the water calorimeter. The heating curve obtained is shown by graph P—Fig. 17—the average or surface temperature of the cubes in degrees Fah. being plotted against the heating period in minutes.

The cubes are heated by radiation and by convection. To work out the values of H_c and H_r—the rate of heat transfer in B.Th.U. per square foot of cube surface per hour per degree Fah. temperature difference by radiation and by convection—at any ordinate of the heating curve, the period from two to three minutes is selected. The data required are as follows :—

(a)	Average cube temperature	278 deg. Fah.
(b)	Cube temperature rise in one minute	54 deg. Fah.
(c)	Average temperature difference	122 deg. Fah.
(d)	Weight of six cubes	0·031 lb.
(e)	Surface of six cubes	1/64 sq. ft.

Taking the mean specific heat of copper over the temperature range in the period to be 0·10, the rate of heat supply to the cubes in B.Th.U. per square foot per hour is

$$0{\cdot}031 \times 54 \times 0{\cdot}10 \times 60 \div \frac{1}{64} = 643$$

Hence

$$(H_c + H_r) = \frac{643}{122} = 5{\cdot}27$$

By Table I.—November 7th—the heat supply by radiation per square foot of cube surface per hour from the furnace walls at 400 deg. Fah. to the cube surfaces at 278 deg. Fah. is 879·2—477·2=402 B.Th.U.

Hence

$$H_r = \frac{402}{122} = 3{\cdot}30$$

and

$$H_c = (5{\cdot}27 - 3{\cdot}30) = 1{\cdot}97.$$

Referring to graph Q—Fig. 17—and to the curves A B and C D, the above values of (H_c+H_r) and H_c are plotted against the cube surface temperature of 278 deg. Fah.

1in. Copper Cube in Copper Furnace. W=0.—Using a single cube supported on a grid, a heating curve was obtained and the values of H_c+H_r and of H_c deduced. The results are shown on graph Q, curves E F and G H. A summary of the copper furnace experiments is given in Table VI. below.

TABLE VI.—*Copper Cubes in Copper Furnace.*

Side of cube, inches.	Furnace temperature, ° F.	H_c average value.	(H_c+H_r) average value.	Graph letter.
1	400	1·3	4·5	Q
¼	400	1·8	4·9	Q

The values of H_c are based on the temperature difference between the copper cubes and the furnace walls, this being convenient for the ultimate purpose. The air in the furnace will, however, be at some intermediate temperature, since it receives heat from the furnace walls and transfers it to the cubes.

1in. Copper Cube on Velocity Apparatus.—Using W=2800 and a hot air temperature of 750 deg. Fah., a heating curve was obtained and analysed for values of H_c. For the period of three to four minutes on the graph the data are as follows :—

(a)	Hot air temperature	752 deg. Fah.
(b)	Average surface temperature of cube	507 deg. Fah.
(c)	Temperature difference air and cube	245 deg. Fah.
(d)	Rise of cube temperature per minute	58 deg. Fah.
(e)	Weight of cube	0·302 lb.
(f)	Specific heat for temperature range	0·103

Heat entering cube per square foot per hour

$$= 0{\cdot}302 \times 58 \times 60 \times 0{\cdot}103 \div \frac{6}{144} = 2598 \text{ B.Th.U.}$$

From Table I. the heat lost by radiation from the surface of the cube, to the water jacket and atmosphere—mean temperature 78 deg. Fah.—is 1405—135=1270, hence the total heat supplied to the surface of the cube, by convection, per square foot per hour, is—

$$2598 + 1270 = 3868 \text{ B.Th.U.}$$

Dividing by the temperature difference we obtain

$$H_c = \frac{3868}{245} = 15{\cdot}8$$

at a surface temperature of 507 deg. Fah.

This result is plotted on graph R—Fig. 17—which also shows values of H_c for a 1in. copper cube, with W=400 and a hot air temperature of 720 deg. Fah.

A summary of the copper cube experiments on the velocity drying apparatus, is given in Table VII. It will be seen that the value of H_c is affected considerably by the value of W used, but only to a small degree by the hot air temperature.

TABLE VII.—*Copper Cubes on Velocity Drying Apparatus.*

Side of cube, inches.	Hot air temperature, deg. Fah.	Value of W.	H_c average value.	Maximum cube temperature, deg. Fah.	Graph letter.
1	400	400	4·8	320	—
1	720	400	5·8	527	R
1	400	2800	14·5	369	—
1	750	2800	14·6	638	R
½	400	1600	15·8	365	—
½	700	1600	16·1	599	—
½	400	2800	21·2	375	—

Radiating Power of Dry Clay Cubes.—When applying the results of the copper cube experiments to the heating of clay cubes, it is necessary to know the radiating power of clay. A cube of clay of 1in. side was prepared, and carefully dried.

It was then placed on the drying grid, and heated for three hours with the following result :—

Value of W	2800
Hot air temperature	750 deg. Fah.
Final steady temperature of clay cube	651 deg. Fah.
Final steady temperature of copper cube—coated with lampblack—under similar conditions	638 deg. Fah.

It would appear therefore that the radiating power of the dry clay cube was slightly in excess of that of the copper cube.

Experiments on the Drying of Clay Cubes.—The application of the values of H_c, as derived from the copper cube experiments, to the drying of clay cubes, is now considered.

The four graphs illustrating these experiments are lettered S, T, U and V, Figs. 18 and 19. Additional data will be found in Table VIII.

The temperature of the clay cubes after each heating period was taken by the water calorimeter. The specific heat of dry clay, over the range 400 deg. —60 deg. Fah., was estimated by heating dry cubes in the copper furnace for four hours, the furnace temperature being steadily maintained at 400 deg. Fah., and then tipping them into the water calorimeter. The average value so found was 0·26.

One Inch Clay Cube in Copper Furnace at 400 deg. Fah.—The result of this experiment is shown on graph S. The cubes were moulded a few minutes

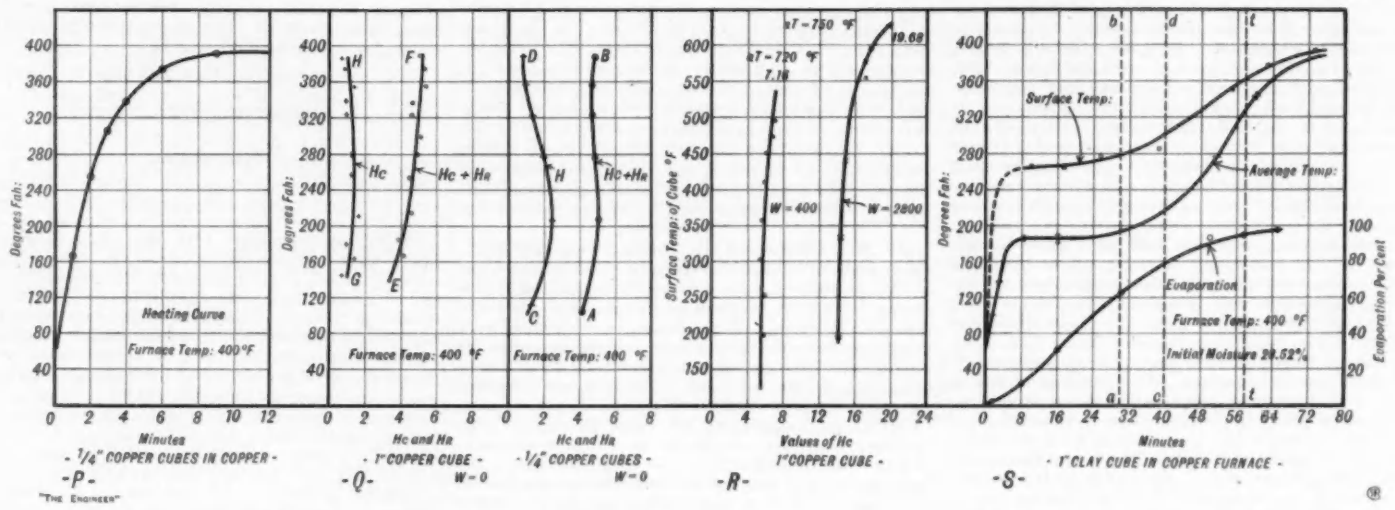


FIG. 17—EXPERIMENTS WITH COPPER CUBES

FIG. 18—EXPERIMENTS WITH CLAY CUBES

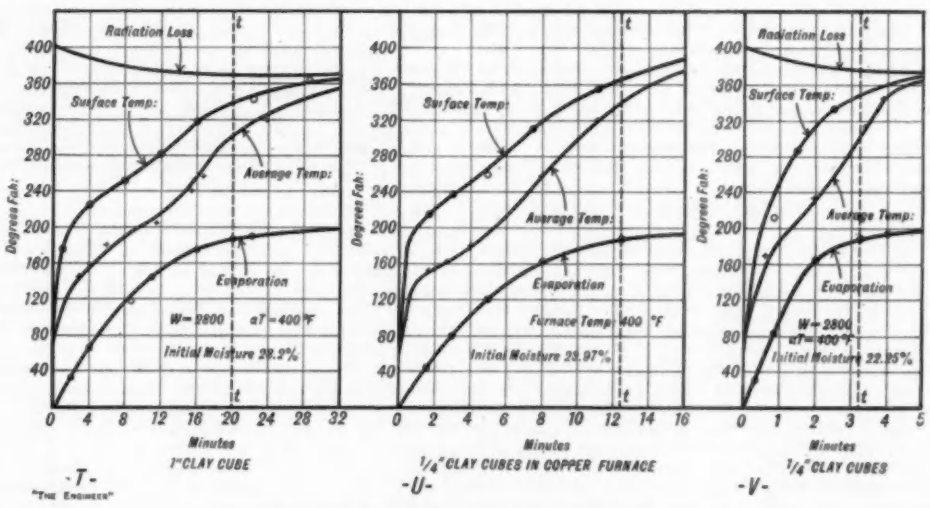


FIG. 19—EXPERIMENTS WITH CLAY CUBES

* No. II. appeared November 14th.

before being placed on the grid in the furnace. The wet weight was taken. After drying for a definite period, the cubes were again weighed for loss of moisture. Finally, they were completely dried and the initial moisture obtained by difference. The curve of evaporation shown on the graph was thus obtained.

A second set of experiments was made in order to obtain the curve of average temperature.

To obtain the cube average surface temperature at any ordinate on the graph, a short heating period is taken—such as that between the ordinates *a b* and *c d* on graph S. The heat necessary to evaporate the water, and to raise the temperature of the cube and the contained moisture is worked out, and the rate of heat supply in B.Th.U. per square foot of cube surface per hour is obtained. The value of (H_c+H_r) is taken from graph Q, line E F, at the estimated surface temperature, and the temperature difference (T *d*) necessary to transmit the heat is calculated. The surface temperature is then 400—T *d*.

On obtaining the surface temperature the value taken for (H_c+H_r) is verified, and, if necessary, the calculation is remade.

It is assumed that heat is transmitted to the surface of the clay cube at the same rate as it would be to a copper cube, coated with lampblack, and of the same surface temperature, since the radiating and, hence, the absorbing, powers of the two cubes, as previously stated, were found to be nearly the same.

A special feature of graph S is the large difference between the average temperature and the surface temperature for a considerable period, when the slow rate of heating is considered. If this difference is correct, it would indicate that the conductivity of the clay was as low as 0·88. Should, however, the operative values of H_c and H_r be less than those obtained from the copper cube experiments a greater value would be calculated for the temperature difference in each period, and the surface temperature curve would be nearer to the average temperature curve. The 1in. cube of clay was dried in a small furnace, 2½in. diameter by 2$\frac{1}{16}$in. deep. The weight of moisture evaporated from the cube would be about forty-five times the weight of air originally present in the furnace; hence the heat transmission would presumably take place in an atmosphere of steam. Under these conditions, it may be that both H_c and H_r would have smaller values than those deduced from the copper cube experiment.

The atmosphere of steam does not, of course, obtain when drying by the velocity apparatus.

Another feature of the furnace drying experiments—and to a smaller extent of the velocity drying experiments—is the rapid rate of heat transmission during the first short period of heating. On graph S the heat transmitted in the first three minutes is at the rate of 1327 B.Th.U. per square foot per hour. The value of H_c+H_r from the copper cube experiments—graph Q—is less than 4; hence a temperature difference greater than 382 deg. Fah. is calculated, thus bringing the surface temperature down to 18 deg. Fah., which is impossible. Apparently a rapid evaporation of the surface moisture takes place during the early heating period, owing to causes apart from H_c and H_r.

Graph T illustrates the drying of a 1in. cube of clay on the grid of the velocity apparatus, the value of W being 2800 and the hot air temperature 400 deg. Fah.

When using the velocity apparatus the drying is delayed by radiation. To obtain the surface temperature at any ordinate on the graph, the rate of heat supply to the cube over a short heating period, is worked out as before. The surface temperature is provisionally assumed, and the rate of heat loss by radiation to surroundings at 78 deg. Fah. is calculated. Adding the two quantities, the total rate of heat supply to the surface of the cube by convection in B.Th.U. per square foot per hour is obtained. H_c, for the assumed surface temperature, is taken from the corresponding experiment on the copper cube, and T *d* calculated. The surface temperature is then 400—T *d*.

The figures are adjusted until the value originally assumed for the surface temperature corresponds to the result finally obtained.

The proportion of the temperature difference between the hot air and the cube surface, which is lost by radiation, is indicated on the graph.

Graphs U and V—Fig. 19—do not call for any comment.

The clay-drying experiments are summarised in Table VIII.

Col. (5) gives the hot air temperature, or the copper furnace temperature when W=0.

Col. (6) gives the value of W used in each case.

Col. (7) gives the time required to evaporate 95 per cent. of the moisture. An ordinate marked *t t* is drawn on each graph at this point. The figures bring out the relatively slow rate of drying by furnace where W=0. The effect of increasing W is more marked in the case of the smaller cubes. The large increase in drying effect due to raising the hot air temperature will be noted.

In lines (1) and (2) in Table VIII. the rates of drying are approximately equal. In line (1), however, the quantity of material dried per hour is limited by the area of the furnace walls, since the necessary heat has to be transmitted from them.

In line (2) the quantity dried per hour depends on the surface area of the material, and large areas can usually be made available. An example is the cascading of material in a rotary dryer.

Col. (8) gives the approximate conductivity of the clay as deduced from the rate at which heat enters the cube during various short periods, and the corresponding difference between the average temperature and the surface temperature of the clay. For firebrick, at the same average temperature, a usual value for the conductivity appears to be from 5 to 6. The conductivity of materials during drying will be again referred to.

Result of Investigation.—In the case of the clay cubes, where the initial moisture is large, apparently the rate of drying in cases not covered by the graphs, would have to be deduced from (*a*) the value of H_c expected, (*b*) the average temperature difference likely to be available, and (*c*) the material surface in square feet per pound. In the case of coal, the average temperature curve is less distorted, and calculations may be more easily made, as will be seen later.

The relation between W and H_c, as obtained for copper cubes, and listed in Table VII., will hold good for cubes of other materials, and should have a wide application in practice.

(To be continued.)

TABLE VIII.—*The Drying of Clay Cubes.*

Side of cube, inches.	Number of cubes per pound (wet).	Initial moisture, per cent.	Surface per wet pound, square feet.	Hot air (or furnace) temperature, deg. Fah.	Value of W.	Time to evaporate 95 per cent. of moisture, minutes.	Apparent conductivity of clay.	Graph letter.
1	15·5	28·52	0·645	400	0	57·2	0·88	S
"		29·00		400	400	56·0	1·55	—
"		28·20		400	2800	20·0	3·00	T
"		30·46		750	2800	8·5	3·25	—
½	913	24·00	2·381	400	0	12·3	0·32	U
"		23·50		400	1600	3·8	1·28	—
"		23·84		700	1600	1·3	1·60	—
"		22·25		400	2800	3·2	1·20	V
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

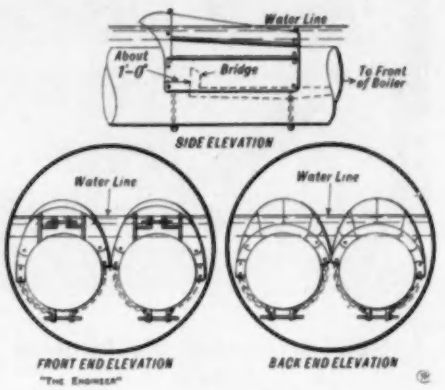
The Owens Boiler Circulator.

FROM time to time various devices have been introduced for improving the circulation in Lancashire and Cornish boilers, and the latest that has been brought to our notice is the Owens circulator, manufactured by Owens Boiler Circulator, Ltd., of 57, Victoria-street, S.W. 1. Essentially, it consists, as shown in the accompanying drawing, of a steel hood or saddle, supported on malleable iron bridges fitted and secured over the hottest part of the boiler, namely, over the back part of the furnace and over the fire bridge. It therefore completely encloses the water space over the hottest part of the boiler, and two spaces are thus provided on each side of the flue, the superimposed curved hood promoting longitudinal and elliptical circulation of the water by utilising the natural force of the steam bubbles. On escaping from the centre of violent ebullition over the fire bridge, these bubbles pass along the inner surfaces of the curved hood and issuing therefrom throw the ascending stream of water in a horizontal direction to the back of the boiler, instead of upwards towards the steam space. The effect, the makers explain, is to prevent the vertical mechanical projection of water particles, or in other words, to prevent priming and to promote such a flow as will continuously draw the water from the lower and colder parts of the boiler over the hottest part of the furnace and to propel it longitudinally towards the back.

Almost immediately after the fires have been started this action is said to be established. Constant and effective circulation is secured, and regular and efficient steaming is maintained, whilst the rapid circulation of the water holds all sediment in suspension and prevents the formation of scale. The circulator is secured to the furnace by means of specially constructed chains, securely anchored in position by means of stretching screws, and it will readily be understood that if it is necessary to dismantle the circulator the work is quite simple and straightforward. As the circulator causes the bubbles to be washed over the surface of the plate, the rate of evaporation is increased by constantly allowing fresh water to come into contact with the heating surface, the principle being to remove the bubbles as fast as they form, with the result that more heat is transmitted through the boiler plates for the generation of steam.

The difference between the coefficient of expansion of boiler scale and metal, the makers go on to explain, brings about the loosening of old scale, which is detached from the inside surface of the boiler by the rapid circulation of the water. Priming is prevented by virtue of the hoods directing the rising steam bubbles in a horizontal direction towards the back end of the boiler, thus utilising the entire surface of the water for their release, instead of allowing all the bubbles to come to the surface within the confined prime heating area. The makers claim that, owing to the rapid generation of steam, an appreciable saving in coal consumption is effected and that boilers fitted with these circulators require less attention than is ordinarily necessary.

Users are said to find that the dirt and scale collected at the bottom of the boiler underneath the furnace at front end can be removed at daily intervals by means of the blow-off cock in the usual manner. As the work of fitting the circulator does not involve drilling or riveting, the strength of the boiler is in no way impaired. The



ARRANGEMENT OF CIRCULATOR

enclosed spaces about the heating surfaces are said to form a very adequate passage for the induction of water from the lower and colder strata to the steam surface, and to equalise temperature after firing has been commenced and until steam begins to generate, whilst by the time steaming begins temperatures are balanced. The apparatus is claimed to create a positive and rapid circulation of the whole body of water, and to maintain every particle of water at or near steam temperature.

At whatever temperature the feed water enters the boiler it is immediately taken into circulation, and the entire body of the water is momentarily reduced in temperature until equalisation is set up between the steam and water by the passage of heat from the furnace. It is asserted that this circulator will pay for itself in fuel alone within twelve months, and that in many cases the cost is saved during the first year of installation in boiler fluids and cleaning.

POWER STATIONS ON SWEDISH RIVERS.

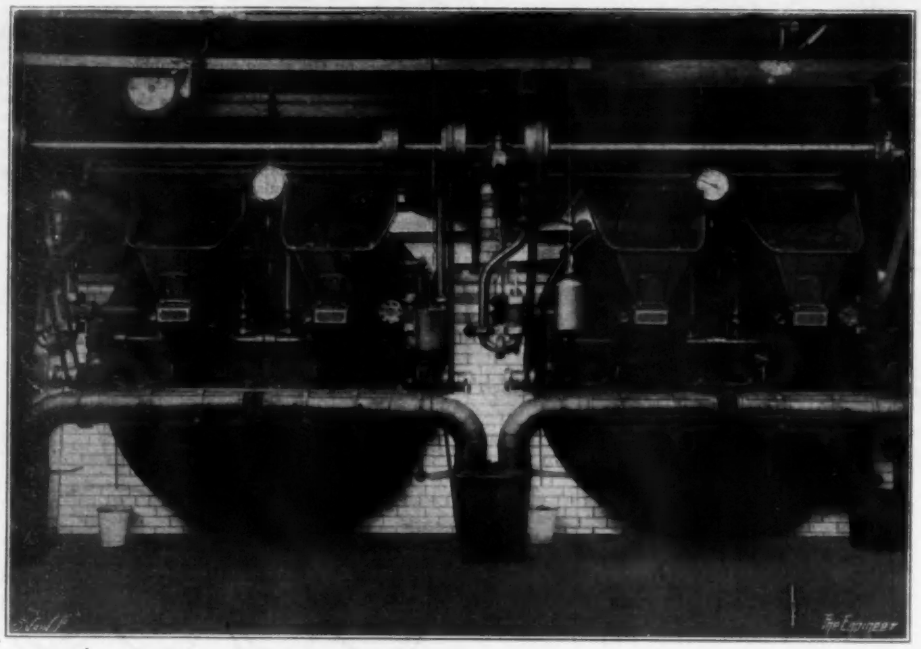
RUMOURS have been circulating lately that a large industrial combine was considering plans for the construction of a big new power station at the Selsforsen Rapids, some 15½ miles from the mouth of the Skellefte River and about 6½ miles from the Kraangforsen Rapids. The Kraangforsen and the Finnforsen Rapids on the same river are already exploited by large power stations owned by the town of Skellefteaa and supplying power to the mining company, Skellefteaa Gruvaktiebolag, and other concerns. The head at the Selsforsen Rapids is about 68ft., and it is estimated that with a normal water level a turbine effect of 30,200 H.P. could be obtained.

Several new big power stations have been completed, or will be completed, this year. At the beginning of the year the power combine Sydsvenska Kraftaktiebolaget started its Karseforsen station of 44,000 H.P. on the Lagen River, and later in the spring the Lanforsen station on the Dal River, yielding 26,000 H.P. for the first stage of construction, was started. Other power stations completed this year are the Aetrofors station, on the Aetran River—15,000 H.P.—the Hoeljebro station on the Ljusnan River—10,000 H.P.—and the Maansbo station on the Dal River—7900 H.P.—owned by Yngeredsfors Kraftaktiebolag, Bergvik och Ala Nya Aktiebolag and Alby Nya Kloratfabriks Aktiebolag respectively. Next year the Lanforsen station will be enlarged by another set of 13,000 H.P., and the Maansbo station by about 8600 H.P. Among other new constructions are one on the Dal River, opposite the above-mentioned Maansbo plant, to produce 7500 H.P., which is being built by Avesta Jaernverks Aktiebolag, and will probably be completed in 1932, and the Munkforsen plants on the Klarelven River, constructed by Uddeholms Aktiebolag, to produce 30,000 H.P. The Water Fall Board has begun preparatory work for a station at Vargoen, north of Trollhaetten, another station on a tributary of the Indal River, at Sillre, and a third at Malfors, on the Motala River, the last-named to be used for the electrification of the Stockholm-Malmoe railway line.

THE Canadian Pacific and Canadian National Railways, together with several aviation companies, have formed an air line, known as Canada Airways, Ltd. The two railways have invested 250,000 dollars (£50,000), and this investment is likely to be appreciably increased when the new company begins work. The air services will be complementary to the rail services.

FAN-DRAUGHT FURNACES IN LANCASHIRE BOILERS

EDWARD BENNIS AND CO., LTD., LONDON, ENGINEERS



A New Air-cooled Mechanical Stoker.

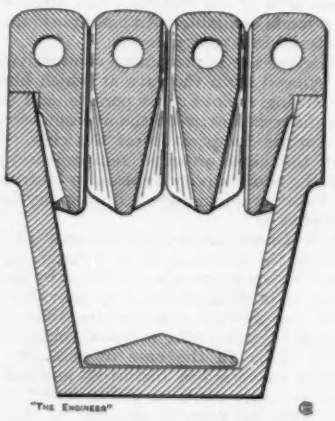
THE mechanical stoker, of which we give herewith a line drawing and half-tone engraving, has been brought out recently by Edward Bennis and Co., Ltd., of 28, Victoria-street, Westminster. In it the familiar Bennis system of sprinkler stoking and reciprocating grate bar for cleaning the fire have been retained, but the old arrangement of steam jets for supplying the forced draught has been replaced by a fan-impelled draught.

It has long been appreciated by boiler-house engineers that without very rigorous supervision the steam jets of the original Bennis stoker may be the source of much waste of steam as firemen have the habit, when left to themselves, of turning on the blast fully, regardless of the operating conditions of the boiler and leaving it so throughout the shift. The result is that, although the steam consumption of the jets may be quite a small proportion of the boiler's output at full load, it represents a serious matter at light loads. Again, the steam jet is admittedly an inefficient means of producing a draught of air, although it has the merit of extreme simplicity.

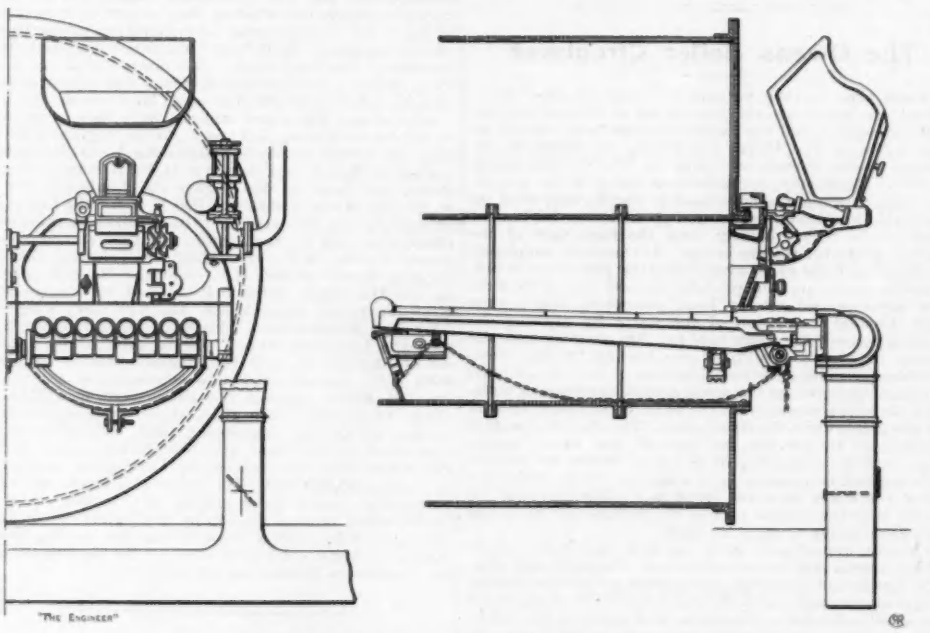
There are some services in which the sending of steam up the smoke stack, and the consequent provision of make-up feed water, are most undesirable; but, on the other hand, if a fan draught is used no water need be lost from the system and a far more efficient apparatus is used for moving the air. It is on these principles that the new Bennis stoker has been developed.

The grate is formed by a series of longitudinal troughs which carry the fire-bars, as shown in the detail section. These troughs are reciprocated, one after another, and gradually work the clinker over the back end of the grate into the ashpit. Into each one of these troughs there is sent a strong blast of air from a duct running across the front of the boiler, which is supplied by a forced draught fan. We have no exact comparative figures as to the consumption of energy by the fan and the steam jets for the same service, but it is obviously in favour of the fan system, and the service which can be obtained in this way is exemplified by the results of tests which we give at the end of this article.

One of the great merits of this fan draught furnace, as compared with the old steam jet furnace, is that air preheated by the waste gases can be fed under the bars. When preheated air is used in a furnace there is, of course, a tendency for cast iron fire bars to grow on account of continued exposure to high temperature. As a consequence the bars of this stoker are cast with a longitudinal passage near the top, as shown in the detail sketch. Along this passage there is delivered a fairly high-pressure draught of cold air to keep the bar itself at a reasonable temperature. This draught is provided by a separate set of nozzles to those used for the combustion air, and may be very conveniently taken from the main air duct on the side before it reaches the preheater. In its passage through the bars this air is, naturally, heated considerably, so it is turned back at the rear end of the bars into the trough below and mingles with the combustion air.



SECTION THROUGH TROUGH



SECTIONS THROUGH FAN-DRAUGHT STOKERS

It will be noted from the cross-sectional sketch that the design of the trough and of the bars has been altered in the new stoker, but the broad principle of narrow air spaces, so that fine coal may be burned without falling through the bars, has been retained. Otherwise the stoker is of the familiar Bennis type, in which the clinker and ash is fed towards the back of the grate by the alternate reciprocation of the troughs, while the coal is sprinkled over the grate by a spring-operated shovel.

Several of these stokers have already been installed in factories of various kinds, and the following figures relating to the performance of two 8ft. Lancashire boilers in a brewery, which have been supplied to us by the makers, will give some idea of the economy they will effect.

	Normal load.	Over-load.
Date of test	1/5/30	1/5/30
Duration of test, hours	7	1
Number of boilers	2	1
Draught in inches of water gauge, over fires, inches	0·16	0·25
Temperature of flue gases leaving boiler, deg. Fah.	640	633
Temperature of flue gases leaving economiser, deg. Fah.	430	442
Percentage of CO_2 in flue gases entering economiser, per cent.	11·8	12·23
Percentage of CO_2 in flue gases leaving economiser, per cent.	9·7	10·4
Temperature of feed water entering economiser, deg. Fah.	153·6	156
Temperature of feed water entering boiler, deg. Fah.	280·6	280
Steam pressure by gauge, lb. per sq. in.	86·4	78·4
Factor of equivalent evaporation as from and at 212 deg. Fah. (boiler and economiser)	1·09	1·093
Name and class of fuel used	Devon washed pearls	
Calorific value of fuel per pound as fired, B.Th.U.	12,295	12,295
Total weight of fuel burnt, lb.	9,856	2,016
Fuel burnt per boiler per hour, lb.	1,408	2,016
Fuel burnt per square foot grate surface per hour, lb.	37	53
Total quantity of water evaporated (actual), lb.	88,754	17,227
Water evap. per boiler per hour, lb.	12,679	17,227
Water evaporated per square foot boiler heating surface per hour, lb.	12	15·8
Water evaporated per pound of fuel, lb.	9·0	8·54
Total equivalent evaporation as from and at 212 deg. Fah., lb.	96,742	18,829
Equivalent evaporation per boiler per hour, lb.	13,820	18,829
Equivalent evaporation per square foot boiler heating surface per hour, lb.	13·08	17·2
Equivalent evaporation per pound of fuel, lb.	9·81	9·33
Total thermal efficiency obtained (boiler and economiser), per cent.	77·9	73·6

Heat Balance.

	Normal load, B.Th.U.	Per cent.
Useful heat taken up by boiler	8,421·36	68·5
Useful heat taken up by economiser	1,157·63	9·4
Useful heat taken up by dry flue gases	1,613·16	13·1
Useful heat taken up by wet flue gases	528·81	4·3
Radiation and unaccounted for	574·04	4·7
	12,295·00	100·0

During the normal load the evaporation in both boilers varied from 5000 lb. per hour to over 20,000 lb. per hour. On the overload test the object was to ascertain the maximum evaporation of the boiler.

FIRING A BOILER.

THE *Far Eastern Review* is a most cosmopolitan journal, and it occasionally provides some matter for thought. Could, although the phraseology is rather quaint, the firing of a boiler be better expressed than in the following passage? With all anthracitous coals, above all those of Hongay, the combustion is not stated or maintained by the easily inflammable volatile matters which keep the fire at a suitable temperature. The best results with Hongay coal can only be obtained with furnaces having a very large heating area directly subjected to the radiation of the fire. When the combustion becomes less active, the pressure in the boilers drop, whilst it is exaggerated when one has to open the doors of the furnace to work the fire, this putting the large heating surface in contact with cold air. Every time Hongay coal has not been found satisfactory it has been due to the fact that combustion has been allowed to dwindle through lack of attention. When there is no forced draught the thickness of the fire on the grate should remain between 6in. and 8in. The fuel must be uniformly spread; the fire must be bright, and the flame clear. If the flame is reddish, then there is too much coal and the combustion is too slow. The formation of very shiny patches must be carefully avoided because these are places where the layer of coal is too thin and where exists an easier passage for the draught than in the other parts of the grates. The hollows thus formed in the layer usually soon become replaced by a dark area owing to the cold air which passes through without resistance. This phenomenon is more to be feared with boilers with forced draught than natural draught, and the currents of fresh air may cause contractions of the metal and eventually up to the breaking of the boiler tubes. The gist of the matter is: that whether with natural or forced draught, the fire must be kept at a high temperature and the best way to do this is to have at all times a uniform layer of fuel on the grates. It has been said that the ash of Hongay coal does not corrode the grate bars or form scales or clinkers. Therefore it is unnecessary to poke the fire, as is usually done by drawing the poker underneath the coal and raking the fuel to the sides to scratch the spaces between the bars. It is indeed a very bad practice. Most coals become slightly softened when they are burning red hot. This

gives a certain cohesion to the burning mass when it is poked and sometimes one may stir layers of bituminous coal for a long time without causing any cinders to fall through the bars in any appreciable quantity. Hongay coals, however, do not soften and on being poked they break, with the result that a large quantity of half-burnt cinders pass through the bars. When from appearance of the furnace one guesses that there is a little ash under the burning coal, it is quite enough, without opening the door of the furnace, to slip the poker under the grate, with its point turned upwards, and to lightly shake the bottom of the burning layer.

New Type of Flooring for Workshops.

A NEW method of forming the flooring of workshops, factories, &c., has been devised, patented and put on the market by La Société Anonyme des Usines Renault, 10, Avenue Emile-Zola, Billancourt, Seine, France. The main constituent parts of the flooring are inverted dished plates of steel of special form. All these dishes, which are all exactly similar to one another, so that they are all interchangeable, are in the form of octagons having four long sides and four short sides, as seen in the upper drawing in Fig. 1. They are made by pressing or stamping, and, during the operation, several things are done in addition to the actual formation of the dish. For example, corrugations of any desired shape—they are shown as concentric circles in our engravings—are formed on what is to be the upper surface of the dish. These corrugations serve two

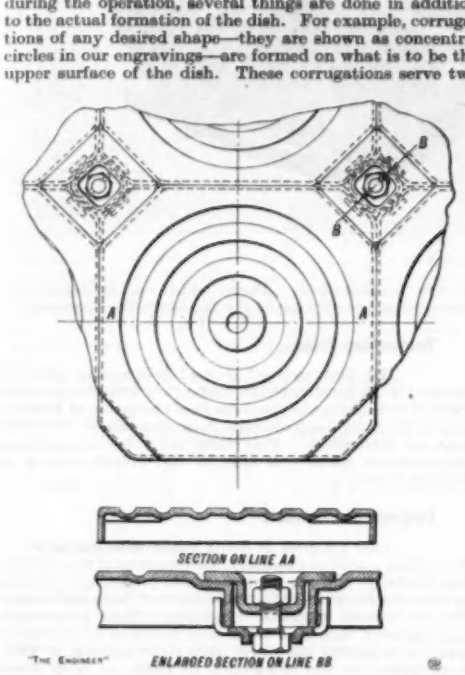


FIG. 1—RENAULT STEEL FLOORING PLATE

principal purposes: they give strength to the dish, and they help to prevent slipperiness which might develop were the surface of the dish to remain smooth. Then, again, during pressing, the surfaces of what may be called the corners of the dish—or the shorter sides of the octagon—are depressed to the extent of the thickness of the plate, as may be seen in the lowest drawing in Fig. 1, which shows an enlarged cross section on the line B B in the topmost drawing. The reason for these depressions will be explained immediately. For assembling the flooring four dishes are first arranged with their long sides abutting against the long sides of the dishes adjoining them. The result is that a square is formed at the junction of four of the dishes, as is seen quite plainly in Fig. 1.

In order to connect all the dishes together so that a homogeneous floor surface may result, use is made of upper and lower junction members and of a bolt or rivet. The upper member, which is a square steel plate of the same thickness as the metal of the dishes, is pierced with a central hole for the passage of the bolt, and is cupped on its underside—as seen in the illustrations—the cupping being sufficiently deep to prevent the end of the bolt or rivet, or the nut, from projecting above the surface of the floor when the dishes are assembled.

The lower member is also pierced for the passage of the bolt, and is, further, furnished with lugs which engage with the head of the bolt and prevent the latter from turning when the nut is being tightened up. This lower member is also made from a square plate, with a square piece stamped out of each of its corners so as to form a cross of Geneva pattern. The outer ends of the arms of this cross are turned up at right angles, as well shown in Fig. 2.

An examination of the lowest drawing in Fig. 1 will show that the cupped portion of the upper junction member fits fairly closely against the outer surfaces of the turned-down shorter sides of the dished floor plate, and that the dimensions of the junction member are such that the member as it rests on the slightly depressed surfaces of the four corners of four adjoining floor plates practically fills the square which is left. As the thickness of the metal of the member is the same as that of the floor plate, and as the corners of the latter are depressed to the extent of the thickness of the metal, the top surface of the upper junction member will come flush with the main floor plates.

As will be seen from the illustrations, the turned-up arms of the cruciform lower junction member, when the latter is applied to the undersides of the dished floor plates, closely embrace the turned-down portions of the short sides of the latter, so that when the bolt is passed through the holes formed in the two junction members, and the nut tightened up, four of the dished floor plates are clamped rigidly together in such a way that they cannot be made to come apart. The suggestion of the makers is that, when laying the flooring, a number of floor plates should be clamped together so as to form a sort of carpet which will facilitate laying, the idea being that the "carpets" thus formed shall be laid on a levelled surface, adjoining "carpets" being coupled together in the same way as the "carpets" themselves are built up, until the whole floor space, which it is desired to protect, has been covered. It is further suggested that cement grout should be forced under the flooring through tubular rivets or through holes made in the floor plates for the purpose.

This form of flooring has, we understand, been successfully applied for shops of various kinds, including aluminium, bronze, and brass foundries, drop stamp shops, motor testing shops, &c.

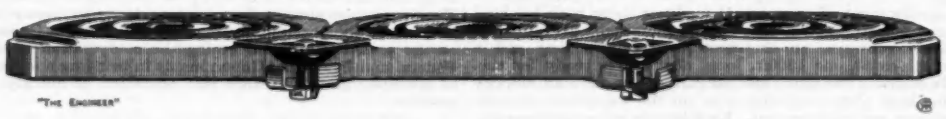


FIG. 2—SKETCH SHOWING METHOD OF CONNECTING-UP FLOOR PLATES

South African Engineering Notes.

Sheffield Steel to be Made.

THE Pretoria Forge and Rolling Mills, Ltd., has been registered in Pretoria to establish a Sheffield steel concern in that town. The company takes over the assets, &c., of the Lawton Machine Tool Company (South Africa). Mr. Joseph Kendrick is one of the directors of the new firm, and is a rolling mill expert who has patented several methods for the manufacture of hollow parallel and taper drill steel. Seventy per cent. of the steel used in drilling on the Rand is, it is said, produced in mills which were installed by him under his patent in Sheffield.

Power Supply to Mines.

Victoria Falls and Transvaal Power Company shareholders were informed at the annual meeting of the company that during the year the demand for electric power had increased by about 4 per cent. It was still increasing, and notifications of further requirements had been received. The directors are of the opinion that the upward movement will continue for some time, in spite of the fact that some of the older mines had practically ceased to take power, for one of the new mines substantially increased its demand and two new properties began to take some power for sinking, development, and other operations. Power is now being supplied by the company to thirty-five mines, which take 97 per cent. of the company's total output.

Union Steel Corporation.

At a special general meeting of the Union Steel Corporation (of South Africa), Ltd., which was held in August, resolutions accepting the terms of the agreement whereby the South African Iron and Steel Industrial Corporation, Ltd., acquires a controlling interest in the Union Steel Corporation, and were proposed and adopted unanimously. It was pointed out that in view of the very serious losses incurred by the Union Steel Corporation since the middle of 1928, there was no doubt that the directors had done the best that could be done, and had obtained an agreement which gave them additional financial facilities urgently required, and above all secured, it was believed, the whole-hearted sympathy and co-operation of the Government. It is hoped that the company had come to a point at which it will be universally acknowledged that, in the face of great difficulties and discouragement, it had deserved well of the country.

New Ford Factory.

The Ford Motor Company of South Africa has now taken possession of its new factory in Port Elizabeth, which cost over £60,000 to build. The change over has been accomplished without any break in the normal routine, though it occurred at a very busy season consequent upon the introduction of the new style bodies. The factory proper covers an area of 72,000 square feet. A craneway 65ft. wide extends the full length of the building and contains double tracks, one for the ingoing material and one for outgoing finished cars or trucks. An electric travelling crane, capable of lifting 5 tons, runs the full length of the craneway. The railway tracks extend 500ft. outside the building at the rear, and beside them are situated loading platforms, blacksmith shop, paint storage building, and a 30,000-gallon water tank 60ft. high and connected up with the sprinkler system with which all the buildings are equipped. The combined area of buildings and ground is slightly over 9 acres. The factory is equipped to turn out 12,000 cars and trucks per year.

Air Survey in Rhodesia.

A few months ago, the offer of the Aircraft Operating Company to carry out an air survey of 63,000 square miles of unmapped territory in Northern Rhodesia was accepted by the Colonial Office. The company was also asked to make air surveys of six Northern Rhodesian townships. Photographic work began in the first week of May. Altogether the expedition had up to the beginning of September photographed 63,000 square miles of country and taken 15,000 photographs and, in addition, 700 photographs of townships. That work took four months. By ordinary ground survey it would have occupied eight years.

Electric Trolley Omnibuses.

The first electric trolley omnibus landed in South Africa was, early in September, given a demonstration run between Cape Town and Wynberg, in the Cape Peninsula. The omnibus, a six-wheeled double-deck vehicle, came from England. It had not been ordered by any company or municipality, but had been sent out for demonstration purposes. Just now both Durban and Johannesburg municipalities have before them proposals to substitute electric trolley omnibuses for rail-borne tramcars on certain of their routes. The electric vehicle weighs 8¼ tons and its running costs are reported to be approximately 1¼d. per mile.

Rich Torbanite and Coal Seams.

About 22 miles north of Volksrust, in the Transvaal, the putting down of a bore-hole for water revealed the presence of a seam of torbanite 13ft. 6in. in thickness and very rich in oil. It was found at a depth of 180ft., the drill passing through sandstone all the way down. As the drill went through the shale, oil came up freely with the water, and the drill was heavily coated with a thick brownish-black oily substance. Twenty-five feet below the torbanite a 9ft. seam of highly bituminous coal was found. The coal was very bright in appearance and highly inflammable in character, as, placed in an open fire, fragments immediately flared up into a flame giving off a heavy thick smoke. Men with experience of coking coals state that it is, in appearance, the best coal for coking purposes they have yet seen in South Africa.

Rhodesia-Walvis Bay Railway.

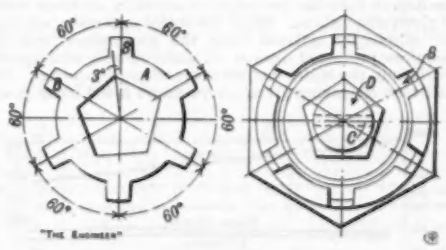
The Prime Minister of Rhodesia, Mr. Moffat, recently announced that a definite step forward had been made in building the Walvis Bay Railway line. That was not, he stated, to be taken as meaning that the line was to be built at all, or at any specified time, but that the three Governments concerned—South-West Africa, Bechuanaland Protectorate, and Southern Rhodesia—had now arranged for the survey to begin. This important step was arranged quite recently. Work will be started as soon as arrangements can be made for the staff to be collected and so on. When the approximate cost is known, the Government will be in a position really to consider the building of the line.

Irrigation in Northern Zululand.

At the end of September there were six surveying parties in the field along the Pongola River Valley, working on a proposed irrigation scheme which, it is roughly estimated, will cost about a quarter of a million and will serve some 50,000 acres, suitable for cotton, sugar cane and other crops. An endeavour is being made to complete the survey as quickly as possible, so that the complete scheme may be laid before the Government for a decision next year. Union Air Force aeroplanes have been employed to assist the ground engineers in their work.

A Novel Castle Nut.

AN interesting development of the castle nut arrangement, based upon the inter-relation of prime numbers, has been developed by Professor Rateau, an account of which is given in *Comptes Rendus des Séances de L'Academie des Sciences*. As will be seen from the illustration, the bolt carries a star piece A, having six branches B, which fit into the recesses on the castle nut, a clearance of about 3 deg. being provided between the branches on the star piece



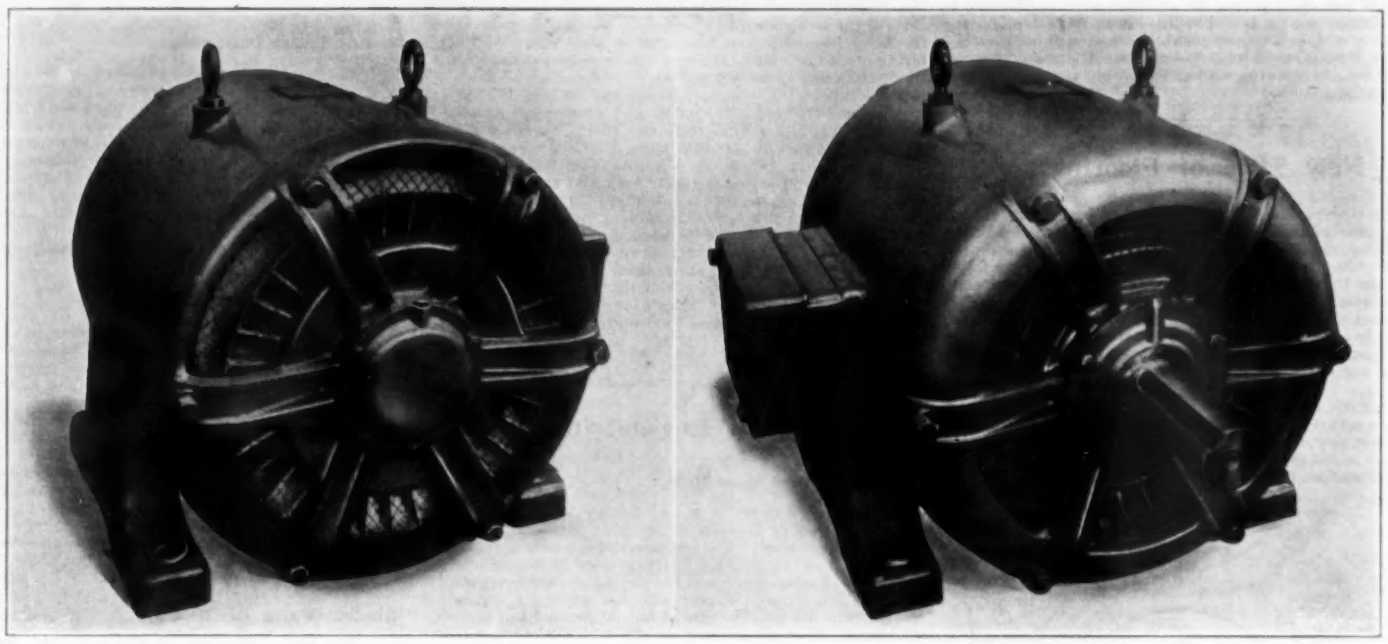
THE RATEAU CASTLE NUT

and the recesses on the nut. The centre of the star is provided with a hole of pentagonal form, which is an exact fit on a corresponding pentagonal prism on the bolt D, the star being held in position by a split pin C. The angle of a pentagon is 108 deg., and that of a hexagon 120 deg., so that, five and six being prime to each other, in one of the five different positions of the star on the bolt agreement within 12 deg. must be obtained between the branches of the star and the recesses of the nut. Turning the star piece over, agreement must be obtained within 6 deg., so that as there is a clearance of 3 deg., at the worst it is only necessary to turn the nut 1·5 deg. either one way or the other in order that agreement can be effected. Thus, the lock is sensitive to within $^1/_{120}$th of a turn, which, for all practical purposes, is negligible. In other words, a positive lock is obtained for all positions of the nut on the bolt.—*Faraday House Journal.*

THE German broadcasting station at Mülacher, near Stuttgart, which is of 60 kilowatts, started work on the 20th inst.

100 H.P. THREE-PHASE TOTALLY-ENCLOSED INDUCTION MOTOR

WALTER McGEE AND SON, LTD., PAISLEY, ENGINEERS



Totally-Enclosed Squirrel Cage Induction Motors.

DURING a recent visit to the works of Walter McGee and Son, Ltd., of Paisley, a new totally enclosed motor was brought to our notice. It is well known that ordinary totally-enclosed machines without special ventilating arrangements are large for their output, and consequently more expensive than open-type machines, and that for a considerable time past this firm has made the "Emcol"

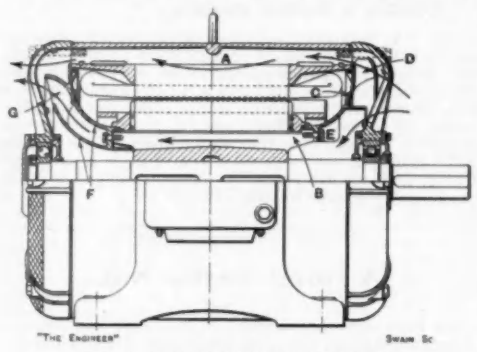


FIG. 1—SECTION THROUGH MOTOR

totally enclosed ventilated motor, which is designed to minimise the difficulty. The "Emcol" motor is still being manufactured, but the new machine, which is known as the Y type, represents the latest effort that has been made by the firm to increase the output of a totally enclosed motor of given dimensions. While the stator and rotor windings are effectively isolated from the atmosphere and are therefore protected against all unfavourable atmospheric conditions, the stator and rotor are efficiently cooled. The half-tone engraving given above shows a 100 horse-power

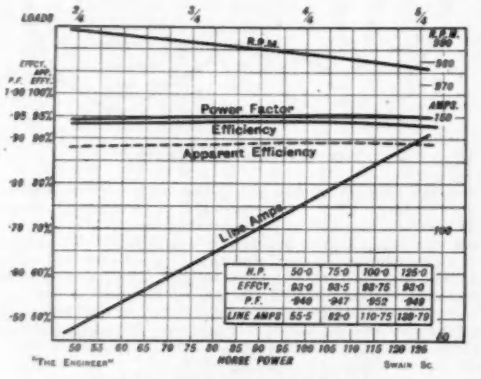


FIG. 2—PERFORMANCE CURVES

three-phase, 50-cycle machine designed for a speed of 1000 revolutions per minute, and for a pressure of 440 volts, whilst Fig. 1 is a section of a motor built on the improved principle.

It will be seen that the windings and vulnerable parts are completely sealed from contact with the outside atmosphere, and by following the arrows the simple method of cooling will be understood. On each end of the rotor a fan is fixed, one forcing an external current of air behind the stator core and inside of the frame, whilst the other draws a current of air through the rotor core, thus providing efficient cooling. In the drawing the stator air ducts are shown at A and the rotor ducts at B. At the air admission end of the machine there is a diaphragm C carrying impeller blades D and E, whilst at the discharge end there is a diaphragm F carrying blades G. The core is held in the casing by rings, is keyed and is pressed up hydraulically. The end shields, which are of substantial design in order to minimise vibration, are fitted with roller bearings at the driving end and ball bearings at the opposite end, and are lubricated by means of grease cups, great care being taken to prevent any chance of grease penetrating inside the machine. The standard motors, as shown in the illustrations, can be bolted to the floor, wall or ceiling, or may be placed in any position provided the shaft is horizontal, and motors are also supplied for vertical or inclined mounting. Plugged sight holes are provided for inspection of the air gap.

The curves, Fig. 2, represent the performance of the 100 horse-power, squirrel-cage motor shown above which was built for Michael Nairn and Co., Ltd., linoleum manufacturers, of Kirkcaldy. In addition to this type of motor, the firm is also manufacturing an improved machine embodying all the "Emcol" patents and is therefore able to offer a complete range of totally enclosed motors suitable for all purposes. Up to the present the new ventilating system has only been applied to induction motors, but a direct-current motor is being developed on the same lines, and will shortly be placed on the market.

Canadian Engineering News.

Vancouver's Municipal Airport Opened.

THE new municipal airport on Sea Island fronting the north arm of the Fraser River, British Columbia, which was officially opened by Lieut.-Governor R. Randolph Bruce recently, places Vancouver definitely among the vanguard of Canadian cities in respect of preparation for the increasing development of air transportation in Canada. With two successive by-laws, each sanctioning the expenditure of 300,000 dollars, the ratepayers of Vancouver provided for the buying of 460 acres on Sea Island and the development of exceptional facilities there both for land and seaplanes. The first unit of the airport contains two main runways, an east-west strip 2400ft. long and a north-south one 1900ft. long, now nearly ready for use. In addition two municipal hangars, one on the main runway for land planes and the other on the waterfront for seaplanes, are being erected. Each hangar will contain accommodation for twelve planes and storage space, workshops, offices, pilots' room and other conveniences. The administration building is designed in three units and will dominate the entire airport. A 1300ft. channel will be dredged to permit seaplanes to taxi to the landing stage and Customs offices. The main east-west runway for land planes will be well over three-quarters of a mile long and 500ft. wide. A centre circle of solid pavement, on the south side of which is the administration building, will be 1000ft. in diameter and will provide a take-off area for all land machines. The building is to contain a large waiting room, restaurant, rest rooms, air companies' offices and general headquarters. The manager and his staff will be housed there and the tower will contain the control station to flash the arriving and departing signals to machines on the runways, in the seaplane channel and in the air. A control system similar to that in use at Croydon will be evolved. The ceremonies included the formal lighting of a 21,000,000 candle-power beacon, which is situated on the roof of the Hudson's Bay Company's store in the centre of the city. It is the largest airway beacon yet constructed in Canada. It stands 200ft. above the street and it will be visible for 100 miles. In addition, the beacon incorporates a powerful directional light of 2,000,000 candle-power, pointing in the direction of the landing field. These additional facilities were provided at the expense of the Hudson's Bay Company.

Briquetting Plant.

The first unit of a coal briquetting plant is planned to be constructed in connection with the development of the holdings of the Gebo Coal Company, of Edmonton, Alberta, in the Mountain Park area, about 165 miles west of Edmonton. This unit of a low-temperature carbonisation plant will cost in the neighbourhood of 100,000 dollars.

Progress at Churchill.

Good progress is being made with the work of developing a port at Churchill, the terminus of the Hudson Bay Railway, and the constructional programme decided upon in the winter of 1927–28 has not only been maintained but, in certain respects, exceeded. That programme contemplated sufficient work and facilities to permit of practically testing the route during the autumn of 1931. It provided for the completion of 600ft. of deep water dock by the end of the present season, the tidal use of the harbour during the entire season of 1932, and the complete use of the port by the end of that season. Extra effort is, however, being made, and it is expected that at least 900ft. of dock will be completed before the closing down of the work this autumn, while the entire 1800ft. of dock is expected to be available by September of next year.

Labour Problems.

The Labour Parliament of Canada, otherwise the Trades and Labour Congress, held its 46th annual Convention in Regina, Saskatchewan, recently, when a wide range of subjects was discussed. One of the most interesting matters before the Congress was a resolution proposing increased taxation of persons and companies engaged in the transportation of freight by motor. It averred that the railway workers of Canada were suffering from reduced employment, due, in part, to the competition of trucking companies with the railways. As the railways are compelled to maintain their own roadbeds and the trucks use the public highways to which they contribute only a fraction of the cost, it is claimed that they are able to carry freight at rates below those set by the Railway Commission. The Convention approved a resolution declaring unemployment to be the biggest issue facing the workers of Canada at the present time, and urging the co-operation of the Federal and Provincial Governments in bringing a scheme of unemployment insurance into operation as quickly as possible.

Creosoting Plant to be Increased.

The capacity of the North Vancouver plant of the Vancouver Creosoting Company, Ltd., is being increased 50 per cent. to meet the peak loads of business. The improved plant will have the largest cylinder capacity among the fourteen Canadian creosoting units associated with Canada Creosoting Company, Ltd., of Montreal, which in turn is controlled by the Dominion Tar and Chemical Company, Montreal. The extension programme of the Vancouver Creosoting Company involves the addition of one treating cylinder unit, 27,000 square feet of new creosoted piling and timber wharf construction, and two new creosote oil storage tanks to provide a storage capacity of 2,000,000 gallons.

Transmission Lines.

The province of Ontario's bid for the electrical supremacy of Canada and of the whole world is emphasised in the completion of another of the long-distance high-tension and high-powered transmission lines for which the Central Canadian province is famous. The present event is the placing in commercial operation of the second 220,000-volt steel tower transmission line between Paugan

Falls, Quebec, and Toronto. The voltage is Canada's highest, and 150,000 H.P. of electrical energy is now being transmitted the 230 miles to the Toronto Leaside station, where it supplements the power supplied from Niagara Falls. The erection of the second line ties the powerful Paugan Falls hydro-electric station, on the Gatineau River north of the city of Ottawa, more strongly with Leaside. The new power line cost in the neighbourhood of 5,000,000 dollars. It is carried on steel towers 73ft. in height, with the towers spaced at an average of one-fifth of a mile apart. The two lines, the old and the new, are about 100ft. apart. Like its predecessor, the new transmission line conductor is aluminium with a steel core for additional strength, the outside diameter being 1¼in.

Mining Laboratory.

Construction is to be started immediately on an addition to the mining building of the University of Toronto. The building will be enlarged to approximately four times its present dimensions. Room will be provided for a main mining laboratory as well as iron ore, cyanide, flotation and assaying laboratories. The addition will cost approximately 200,000 dollars.

Alberta Bituminous Sands.

The experimental plant of the Alberta Research Council used in the separation of bitumen from the tar or bituminous sands of Northern Alberta has been sold to Max W. Ball, petroleum engineer, of Denver, Colorado, U.S.A. The plant, which is situated on the Clearwater River near McMurray, will be taken over by the Denver purchaser and re-designed, re-equipped, and expanded for use in the commercial development of bituminous sands. The past season's work at the plant had shown that a final product could be obtained in a practical way. The plant was in operation this year from June 1st and in the interval it has produced several thousand gallons of oil from the bituminous sands.

Another Nickel Plant.

The Canadian International Nickel Company is proceeding with a further expenditure in the neighbourhood of 2,000,000 dollars for one more plant in connection with the tremendous development programme now nearly completed. This new plant at Copper Cliff, Ontario, which is to operate in about nine months, is for the purpose of handling the separation of nickel and copper matte.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

DISMAL trading conditions persist in the Midlands and Staffordshire, and producers of iron and steel, engineers and manufacturers, alike express concern as to the immediate future. There are no signs of a break in the clouds which obscure the horizon for the bulk of Midland industries. Activity is limited, business is slack, competition is keen, and enterprise fails to bring reward, so that a policy of "marking time" has been fairly generally adopted. There is a disposition to become despondent, but it is being fought tooth and nail in the Midlands, despite the fact that the demand for iron and steel is poor. Constructional engineers have nothing but a few small schemes on hand, general engineers are quiet in all departments, and Black Country industries are almost starving. Even boilermakers, who have done fairly well up to now, are finding difficulty in keeping all their hands employed. New orders are not being secured to replace those being completed. The nut and bolt trade in Darlaston continues to decline, as does the tube trade. The edge tool industry shows further shrinkage, and is now described as "dead slow." Overseas markets are buying practically nothing. Automobile engineers are naturally at this time of the year a little more active, but engagements are much below normal, and those industries associated with the motor trade are only moderately employed.

The Pig Iron Surprise.

The reduction of half a crown per ton in Midland brands of pig iron, announced at the conclusion of last week's iron trade meeting in Birmingham, was indeed a pleasant surprise. The calling of a special meeting of the Pig Iron Producers' Association after it had so recently reaffirmed prices was in itself unusual, and it suggests that, after all, blast-furnacemen realised the danger of permitting foreign iron to be bought and used in a district which customarily used only native material. The 2s. 6d. per ton reduction makes Derbyshire No. 3 foundry £3 11s. and Northamptonshire £3 7s. 6d. The latter material is now competitive with Luxemburg iron in price, but its superior analysis should ensure its purchase, quite apart from the question of delivery facilities, which in these days of hand-to-mouth buying is of great importance. Sellers of foreign pig will have little chance of booking new business while values remain as at present. The demand for pig iron continues very restricted, owing to the quietness at the foundries. Orders are all for small tonnages, and are not sufficient to make much impression upon the stocks at furnaces. It is not to be expected that in the present condition of trade the reduction in the price will bring supply and demand into equilibrium, but it should ensure all the available business going to local furnacemen, and should stem the tide of discontent which was flowing in Midland iron-consuming circles. Foundrymen did not welcome the Association's intimation that "in order to stabilise prices, no further reduction in the minimum price will be made before January 31st, 1931." The new prices have done little, if anything, towards stimulating business, consumptive demand being so poor. Some business has, however, been put through at the new prices, which are:—Northamptonshire: Forge, £3 2s. 6d.; No. 1 foundry, £3 10s. 6d.; No. 2, £3 9s. 6d.; No. 3, £3 7s. 6d.; No. 4, £3 6s. 6d. Derbyshire: Forge, £3 6s.; No. 1 foundry, £3 14s.; No. 2, £3 13s.; No. 3, £3 11s.; No. 4, £3 10s.—delivered at stations in the Black Country.

Staffordshire Bar Iron.

In the Staffordshire iron trade business is quiet. Marked bar makers are in a better position than other branches, but the scarcity of new business is greatly reducing the bulk of order books. Selling prices remain firm at £12 10s. per ton at makers' works. There has been some little movement of late in the Crown bar department, and though it has not amounted really to much, it has been sufficient to intensify competition. Although most makers continue to quote up to £10 7s. 6d., the minimum figure of £10 has been cut, and some ironmasters who for months have not varied their quotation from the maximum have this week intimated that in the event of a substantial order they would be prepared to accept a lower figure. In the nut and bolt and fencing branch, business is bad, local ironmasters being unable to compete with their foreign rivals. Belgian No. 3 iron is procurable at £5 5s. or less, delivered, against Staffordshire iron masters' minimum selling figure of £9. The minimum price for wrought iron strip is £10 17s. 6d. per ton, but it is possible, makers claim, to get a little more when the order is for only a small tonnage.

Steel.

The steel trade shows no new feature. There is a great scarcity of steel specifications, especially for that used in the constructional engineering trade. In this industry contracts are limited to numerous small jobs calling for light tonnages of steel. A few contracts have been placed for railway work in the South of England, which includes reconstruction of goods depôts and passenger stations. A number of small jobs are being undertaken for private owners, but there is no bulk in the tonnage wanted in the Midland area. Prices of heavy steel are unchanged at £8 7s. 6d. for angles, £8 10s. for joists, and £8 17s. 6d. for ship, bridge, and tank plates—subject to rebate. Boiler plates sell at £9 10s. per ton upwards. Staffordshire hoops continue to be quoted £10 at makers' works. Staffordshire re-rollers quote £7 12s. 6d. for small steel bars rolled from continental material, and £8 to £8 5s. if rolled from native billets. Mild steel billets are to be had at £5 15s., and sheet bars at about £5 12s. 6d. Sellers of foreign semis continue their efforts to secure additional business, but a number of consumers of this class of material have booked their requirements over the next two or three months, and are not prepared to risk anything beyond that time, owing to the uncertainty of prices. Business accordingly is quiet. Values are much as last week. Sheet bars have, however, appreciated somewhat, and £4 8s. was asked in Birmingham this week against £4 6s., which was the acceptable figure a week ago. There is no change in the conditions recently ruling in the steel scrap department.

Galvanised Sheets.

Makers of galvanised sheets are seriously concerned at the lack of business emanating from overseas markets, especially as a continuance of the hand-to-mouth policy of buying is considered probable. Last month's shipments of galvanised sheets abroad were of the value of £428,567, whereas in October a year ago exports were valued at £958,636. Moreover, shipments for the year to date were only of the value of £5,511,093, as against £9,695,969 in 1929. The outlook is reported by agents abroad to be discouraging, even in the usually good markets of South Africa and India. Prices are maintained at £11 12s. 6d. f.o.b. for 24-gauge corrugated sheets. The general quotation for India is £11 15s. c.i.f., but probably this would be shaded for a substantial order.

Trade Returns.

The returns of exports and imports of iron and steel and manufactured metal goods during the month of October have been carefully perused by Midland industrialists in an endeavour to trace, if possible, any tendency towards improving trade. They have not proved very helpful, however, for it is noted that the value of iron and steel exports last month was £4,349,638, a reduction of £1,707,708 on the figure for the corresponding month last year. Non-ferrous metal goods to the value of £987,118 showed a reduction of £643,923 on last October's return. Electric goods at £981,537 showed a reduction of £393,006; machinery, at £4,127,796, a reduction of £695,224; and vehicles, including ships and locomotives, at £3,864,889, a decrease of £147,424. On the other side, however, imports are increasing. The total quantity of iron and steel imported during the month was 264,480 tons, valued at £1,989,408, compared with 248,499 tons and £2,131,327 in the corresponding month of last year. For the year to date the quantity imported was £2,415,540 tons, valued at £19,653,665, compared with 2,309,798 tons and £20,325,386 in the preceding year.

Warwickshire Coal Investigation Committee.

The Committee of Investigation for the district of Warwickshire under the Coal Mines Act, 1930, has been appointed by the Secretary for Mines. It consists of Mr. Reginald C. Carter, Chairman; Mr. J. Herbert Aston and Mrs. Robert Thomson, representing consumers; Captain Charles D. Miller, representing owners of coal mines in the district; and Mr. William Johnson, representing the workers. Mr. J. W. Jessop has been appointed secretary to the Committee. It will be the duty of this Committee to investigate any complaint with respect to the operation of the scheme, already approved by the Secretary for Mines, for regulating the production, supply, and sale of coal by owners of coal mines in the district, other than a complaint which could be referred to arbitration by the complainant under the provisions of the scheme.

Unemployment.

A fall of 3701 in the number of registered unemployed in the Midland area on the week is very welcome after the recent persistent increases. There are now 192,777 wholly unemployed, 99,882 temporarily stopped, and 456 normally in casual employment, making a total of 293,115. Of these, 202,221 are men, 5987 boys, 79,325 women, and 5582 girls. The unemployed in Birmingham now number 51,183.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Another Victim of Reorganisation.

IN my note of last week, under the title given above, I inadvertently wrote General Electric Company, Ltd., when English Electric Company, Ltd., was meant. The slip must have been obvious to your readers, as "Preston" and "Dick Kerr's" were mentioned in the same connection, but I desire to apologise to the General Electric Company, Ltd., for any inconvenience the mistake may have caused.

Textile Machinery's Slump in Export Markets.

THE long-awaited improvement in foreign trade in British textile machinery seems to be as far away as ever. Not only are the October trade returns relating to this branch well below the level of a year ago, but they are also below the average for this year. The total shipments last month were 8319 tons, valued at £735,612, including 6527 tons of spinning and twisting machinery, valued at £123,315, and 1377 tons of weaving machinery, valued at £123,315, the total comparing with 8389 tons and £837,712 in October, 1929. There has been a spurt compared with last year in the shipments to the Russian market, but in all other directions, including India, exports have fallen off. The Indian market, however, still holds a commanding poistion, shipments thence during the period under review reaching a value of £244,381. Russia comes second with £54,216, followed by Japan £43,884, Germany £35,443, China—including Hong Kong—£32,099, the Netherlands £28,187, the United States £21,513, France £20,352, South America £18,289, and Australia £18,711, "other European countries" accounting for shipments which, in the aggregate, were valued at £121,803.

Manchester's "Tube" Scheme.

Prospects of Manchester's much-talked-of underground railway scheme becoming an accomplished fact seem now to be regarded less hopefully than they were a month ago. It may be recalled that about the middle of October a joint conference of representatives of the Manchester Underground Railway Committee and of the London, Midland and Scottish Railway Company was held here for the purpose of preliminary discussion, and it was announced that a further joint conference would be held at an early date to discuss financial and technical details. According to a statement made during the past few days by Alderman Bowie, who is chairman of the Underground Railway Committee, the prospects of the "tube" plan coming into being are at the present time regarded as rather remote, the difficulties being chiefly of a financial nature. Alderman Bowie expresses his conviction that some day there will be an underground railway in Manchester, but, he says, while the railway company is inclined to join in the scheme it is in much the same position as the Corporation, inasmuch as it has little money to spare at present. The estimated cost of the scheme put forward by the Underground Railway Committee was in the neighbourhood of £8,000,000.

Bridge and Road Project.

The General Purposes Committee of Heywood Town Council has approved an amended scheme for submission to the Unemployment Grants Committee for the construction of a bridge and certain road works at an estimated cost of £39,403.

University Appointments.

Mr. A. V. Wilson and Mr. F. L. Barrow have been appointed Assistant Lecturers in Building Construction at Manchester University.

Non-ferrous Metals.

Firmer conditions have characterised the market for non-ferrous metals during the past week, with the copper section easily attracting most interest. Speculative influences have had much to do with the latest advances in copper, although the firmer tendency attracted more interest from consumers and the turnover in the metal has been considerable. On balance, the standard market is higher by rather more than £3 on the week, which brings current quotations to a higher level than they have been since about the middle of August. Whether or not the firmer tone can be maintained remains to be seen. The outlook, however, is far from certain in this respect, and a renewed "bear" attack on the position of the metal is regarded as more than a possibility. Other sections of the market have been sympathetically affected. In spite of the fact that the demand for tin has been extremely moderate, and that there has been no real improvement in the statistical position, quotations have moved up to the extent of about £2 a ton. For a similar reason both lead and spelter are higher on balance by about 5s. in each case, notwithstanding that the twin factors of poor demand and plentiful supplies continue to operate.

Iron and Steel.

By far the most important event on the iron and steel markets since last report has been the decline in Midland foundry iron by 2s. 6d. a ton. This reduction has been expected on the Lancashire market for some considerable time, and users have been anticipating the event by a rigid policy of buying from hand-to-mouth. With the official assurance that there will be no further revision of prices, in one direction or the other, before the end of

January, there seems now to be little reason why users should not cover their needs up to that time. So far that has not been done to any appreciable extent, although a pleasing feature is that here and there sellers locally have experienced a slight improvement in the total quantity of iron going into consumption. The new rates for delivery to consumers in the Manchester price zone are 69s. 6d. per ton for both Staffordshire and Derbyshire makes of foundry iron, 68s. for Northamptonshire No. 3, and 64s. for forge quality. Scottish pig iron meets with a quiet demand on this market, and values are easy at about 91s. per ton, with West Coast brands of hematite still quoted at 84s. 6d. per ton, both delivered equal to Manchester. There has been no improvement in the demand for bar iron, but Lancashire Crown bars are unchanged at £10 5s. per ton, and seconds at about £8 15s. The demand for heavy steel locally, especially from the constructional branch, continues very slow, and there has been only a quiet call also for high-carbon and alloy steels. Small re-rolled bars are easy at £7 7s. 6d. per ton, with boiler plates at £9 7s. 6d., tank plates at £8 7s. 6d., large diameter bars at £9 7s. 6d., joists at £8 10s., and sections at £8 7s. 6d. Current buying in the case of imported iron and steel materials on this market is sluggish, and orders are confined to small parcels. After a prolonged spell of weakness, however, there are indications that the bottom has been reached, and prices during the past few days have displayed a somewhat firmer tendency.

BARROW-IN-FURNESS.

Hematite.

There is still evidence of a slight improvement in the hematite pig iron trade, but it is only slight as yet. There are a number of cargoes going coastwise this week to Scottish and Welsh ports, but the tonnage is not heavy. It will need a much bigger demand than is being experienced at present to lower the stocks which have accumulated. It is difficult to arrive at a correct figure as regards stocks on hand in the district, but it is well above 100,000 tons. In some works there is as much as 30,000 tons awaiting purchasers. If the steel trade could get going again, then some of this stock could be cleared, as, with the present restricted outputs, the rail departments would absorb a considerable amount produced from the furnaces and transferred for conversion to the Siemens furnaces. Continental business is thin, and the possible reduction in the price of German products is none too pleasant to contemplate. There is a certain amount of American business, but it does not amount to a great deal. The U.S. requirements are down just the same as home needs are. The native iron ore trade is substantially unchanged, and the same remark applies to the business done in foreign ore. There is still no prospect of any activity in the main steel department devoted to rail production. Barrow remains idle and Workington has barely enough to put the plant on for more than one week per month. The hoop mills at Barrow have orders in hand, but the imposing of a tariff by America on the importation of hoops from this country has certainly affected local trade.

SHEFFIELD.

(From our own Correspondent.)

No Improvement.

HOWEVER much one would like to write that an improvement is taking place in the conditions of the local steel trade, it unfortunately remains true that there are, as yet, few signs of such a movement. On that side which relates to the production of ordinary qualities of steel for general use, there are none at all; in fact, the position is worse rather than better. Production at the open-hearth furnaces has undergone no change for the past month, and the quantity of idle plant is much in excess of that which is occupied. Orders are intermittent, and chiefly for small tonnages, so that it is impossible to see work for even a week or two ahead, and there are already fears that it may be necessary to curtail output still further. At the rolling mills and forges which treat the semi-manufactured material, and prepare it to specifications for various uses, very short time is being worked. In the steel sheet department, things are not quite so bad. The reduction of 2s. 6d. per ton in the price of Midland pig iron, which was made last week, is not expected to be productive of much new business at once. In uncontrolled semi-steel, prices are irregular and easier, but the controlled prices are maintained. The scrap market remains stagnant. The Continent is sending a considerable tonnage of scrap into this country.

Manufactured Lines.

On the railway steel side, conditions continue quiet. The home companies are sending in what orders they can for axles, tires, and springs, but the volume is not up to the normal. Work from overseas has been on a small scale throughout the year, and remains so. There is more activity in the buffer department. In some manufactured lines of steel, October showed an advance on the previous month, and several firms are able to report better employment as a consequence. The improvement, however, is only partial, and is to be found more in special types of steel products than in such material as is in everyday demand. The call from the builders of automobiles, for pressings, stampings, and special steel, although not up to the standard of previous years, yet reaches a considerable volume. At the annual meeting of Sheffield Steel Products, Ltd., last week, the chairman reported that the company was doing a growing business in these lines. There is a substantial demand for stainless and heat-resisting steels, but conditions are not so satisfactory in cold-rolled steel and strip.

Another Lincolnshire Blow.

The iron and steel trade of Lincolnshire has fallen off very seriously during this year, and its position now forms a striking contrast to the state of full activity which it had enjoyed for a considerable time. Now comes the news that at the Redbourn Iron and Steel Works of Messrs. Richard Thomas and Co., Scunthorpe, one of the two remaining blast-furnaces was damped down on Saturday, and that by the end of this week the works will be closed entirely. It is hoped, however, that they will be able to restart in the spring. The works have been extensively reorganised and improved during the past two years. Their closing will add over 1000 men to the number unemployed in the Scunthorpe area, bringing the total up to 3000. The cause of the stoppage at Redbourn is given as the unrestricted entry into this country of continental pig iron and sheet bars. For the same reason, the North Lincolnshire Iron Company shut down its three furnaces in July, and prospects of its resuming work are not at all bright. The Frodingham and Appleby Works of the United Steel Companies, Ltd., and the works of John Lysaght, Ltd., in the same area, are working at reduced capacity.

The Heaviest Drop Forging.

A claim has recently been made that the United States holds the world's record for the heaviest drop forging. This claim is based on a forging of 1750 lb., made from a billet weighing 2000 lb. The Sheffield Chamber of Commerce disputes the claim, and states that for some time a local firm has made drop forgings having a finished weight of 1800 lb. from billets weighing 2350 lb.

Sheffield's Electrical Developments.

The Electric Supply Department of Sheffield Corporation is extending its equipment, on tramway and general accounts, and is having to go abroad for some of its new plant. The Committee reported to the last meeting of the City Council that it proposed to spend the following sums in connection with the further supply of electricity to the tramways system:—Sub-station equipment and buildings, £2056; distribution mains, £5975; plant, £9238. The Committee accepted the quotation of A. Reyrolle and Co., Ltd., amounting to £20,000, for certain alterations and additions to the main switchgear at the Neepsend and Blackburn Meadows No. 1 generating stations. The general manager has been authorised to visit certain works on the Continent where plant on order for the Committee is now under construction, and to inspect certain up-to-date power stations where the most modern types of boiler equipment and appliances have been installed. With regard to the last matter, questions were asked at the Council meeting, in reply to which the Chairman of the Committee stated that the plant ordered on the Continent consisted of three 500-kW automatic steel-clad rectifiers for three new sub-stations for tramway supplies, and that the amount of money involved was about £9000. That type of plant was not made in this country. One firm was experimenting, but it refused to tender. The countries the general manager would visit were Switzerland, France and Belgium. [The Committee was apparently misinformed on this point. Such appliances *are* being made in this country and one at least is in actual operation on the distribution system of a municipal corporation. A further appliance is now under construction in the works of another firm; while still another firm has built an experimental appliance which is now under test.—ED. THE E.]

Engines for the Sudan.

Kitson and Co., Ltd., locomotive engineers, of the Airedale Foundry, Leeds, have just despatched to the Sudan the second of a series of six "Pacific" type engines and tenders for the Sudan Government. The engines, which weigh 53 tons each, have to be delivered fully erected on board ship, and all the vehicles have to be in the Sudan, complete in steaming order, to deal with crops in January. Messrs. Kitson are also to build four heavy tank locomotives for the Sudan Railways, to be shipped early in the New Year.

The Lighter Trades.

A few seasonal orders for cutlery and plate have come to hand, and the general trade is therefore rather better employed, but its condition still leaves much to be desired. There are some good orders on hand for the equipment of restaurants and large quantities of goods are being made to the order of cheap bazaars and firms which carry on distribution in return for coupons. The export trade continues poor. The value of the cutlery sent overseas in October was £71,851, which was £230 more than the figure for September, but £48,000 less than that of October last year. While knives showed an advance, there was a decline in scissors, and a heavy fall in safety razor blades. Australia's purchases of cutlery in October amounted to £12,793, which was only a third of the trade done in the corresponding month of last year. The total value of the exports for the first ten months of this year was £749,287, as against £965,127 last year. The export trade in tools and implements is also heavily down. Sheffield firms fully realise the value of educating their customers in the production and quality of the articles which they distribute, and visits to works for this purpose are frequently arranged. A gathering of this kind, on a rather exceptional scale, was held last week, when three progressive firms co-operated in entertaining for two days nearly sixty leading dealers in cutlery and tools carrying on business in the London district. In the course of their tours of the works, the visitors saw how machine knives, saws, hacksaws, permanent magnets, spades, shovels, razor blades, cutlery and crucible steel are created out of the raw material. The visit, one of the results of which will be to dispel any idea that Sheffield is not thoroughly up to date in its methods, is to be followed by others.

New Sewage Works.

When Sheffield extended its boundaries to take in the Handsworth area a year or two ago, there were eight separate sewage works in the new district. Some of them have been extended and enlarged, but there still remain five old ones, and for them one new scheme is to be substituted. The new works will be constructed at Aston-cum-Aughton, in the rural district of Rotherham. Sanction is being sought for the borrowing of £36,000 for the purpose. The work will be carried out by direct labour.

Shipley Gas Extension.

At a cost of £26,000 Shipley Urban District Council has installed a new carbonising plant at its gas-works, and it was officially put into service last week. The plant is on the continuous vertical retort system, and is expected to give greatly improved results, per ton of coal handled, in comparison with the old inclined retorts. It operates smokelessly, and produces a smokeless coke. The contractors were Woodall-Duckham and Co., of London.

NORTH OF ENGLAND.

(From our own Correspondent.)

Mines Act and Trade.

THE difficulty in getting agreements concerning working conditions, outputs, &c., under the Coal Mines Act is causing some uneasiness in industrial circles in the North of England. A stoppage of work in some districts is not ruled out, but generally the opinion is held that there will be no actual stoppage in any sectional area. While negotiations are in progress there is always hope of some acceptable arrangement being arrived at regarding the new hours which come into operation on December 1st. The time is limited, but the parties concerned in the Northumberland and Durham coalfields are continuing their deliberations. The miners' representatives have communicated to the colliery owners the decision of the men that they could not accept the owners' proposals for a spread-over to 90 hours per fortnight of the reduced hours of 7½ per shift under the new Act. Following upon this the owners invited the men's representatives to meet them again to-morrow—Saturday. They have agreed to do so, and it is hoped that the matter will be amicably settled. In the meantime the uncertainty of the situation is detrimental to the coal export trade.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade shows no material improvement on the week. There is still very little life about the market. Demand is, of course, restricted by the general industrial depression, but sales are further curtailed by the very keen competition from other areas. Facilitated by specially low railway rates, Midland iron is coming into the district in increasing volume, while more Belgian iron is being imported at prices with which the Cleveland makers cannot possibly compete. It seems unlikely, having regard to the cost of production, that the Cleveland producers can follow the example of the Midland makers in making a cut of 2s. 6d. per ton. Cleveland prices are steady, and could only be reduced at a direct loss to the producer. Nor is there urgent need for sacrifice, since the ironmasters have not a big surplus, and are able to dispose of such of the output as they have to spare after meeting the needs of their own consuming plants. No. 1 Cleveland foundry iron is 66s., No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge, 62s.

Hematite Pig Iron.

A quiet, steady business is passing in the East Coast hematite pig iron trade, and includes moderate sales to overseas firms. Accumulations at the blast-furnaces are still inconveniently heavy, but are gradually decreasing. Merchants have unloaded their holdings considerably, and are not now inclined to undersell producers. Mixed numbers are quoted at 71s., with No. 1 quality at a premium of 6d. per ton.

Iron-making Materials.

Dealers in foreign ore recognise the futility of attempting to effect sales under existing conditions. Best Rubio ore is stated to be now obtainable at as low as 16s. 6d. c.i.f Tees. Stocks are on a heavy scale, and consumers have large quantities to take under running contracts. Sellers of blast-furnace coke offer good medium kinds at 17s. delivered to North-East Coast works, but consumers are not disposed to pay that figure.

Manufactured Iron and Steel.

There is a perturbing scarcity of orders for manufactured iron and steel. Manufacturers of constructional steel and of railway requisites are turning out fairly large tonnage, and producers of galvanised sheets have rather more work to execute. Semi-finished materials have to contend with the very low prices at which continental products are offered. Prices are steadily upheld. In the scrap trade most descriptions are difficult to dispose of, but some renewal of demand for heavy steel has resulted in an advance of a shilling in the price of that commodity, the quotation for which is now 46s. Borings are no more than 30s., and turnings are offered freely at 37s. 6d.; while ordinary cast iron is on sale at 51s. and heavy machinery metal at 53s. 6d.

The Coal Trade.

Operators in the Northern coal trade are beginning to show some nervousness in their ideas of forward business, the unsettlement caused by the delay in getting the various schemes for the Mines Act finally settled causing a good deal of hesitation. Recent contracts, both for steam and gas coals, also go to confirm the intensity of foreign competition. Germany, according to advices received on Tyneside, has some millions of tons in stock and is eager to dispose of it, while Poland has immense supplies of first-class steam fuel, which is much cheaper than any grades of Northumberland coal. There is no change in the steam coal position. It remains quietly steady for all classes. The amount of fuel in second hands is decreasing, and is not likely to be considerable when the quotas under the new Act begin to operate. Best Northumberlands are

quoted at 13s. 6d. for large and 10s. for smalls. Durham prime steams are steady at 14s. 9d. for large and firm at 12s. for smalls. Many classes of Durham coals are quoted rather firmly, fitters reporting heavy bookings for this month and the earmarking of a good tonnage supply, but others could handle an increased number of orders. Prime Durham gas coals are well cleared up to the end of the year, and are just nominally offered at 15s. 9d. Second gas coals are very plentiful, and although quoted steadily at 12s. 6d. basis, it is difficult to maintain this value. Durham coking unscreened are moving fairly actively, but there is no scarcity, and at 12s. 6d. to 13s. buyers can cover any grade for any date this year. Unscreened bunkers are in good supply at 12s. 6d. for ordinary, but superiors are scarce, and are quoted firmly at 13s. 6d. to 13s. 9d. The export trade for gas coke is quiet, and prices remain steady at 21s. 6d., but the home trade demand is expanding, and this will ultimately increase the firmness of the export position. Patent oven coke is plentiful at 17s. to 17s. 6d. Beehive and superior grade foundry coke are steadily quoted at 24s. to 28s.

SCOTLAND.

(From our own Correspondent.)

Steel.

So far, there is practically no improvement in the market for steel products. For some time back the inquiry has been more encouraging and makers have been a shade more optimistic, but with inquiries failing to produce tangible results, optimistic feelings have waned. The state of the market at present is reflected in the low output at the works generally. Makers are very short of orders, both home and export, and not only is there a considerable proportion of the plants idle, but much difficulty is experienced in keeping the plants left in operation regularly employed. Specifications for shipbuilding materials are very limited, and export demands are largely affected by the unsettled state of the continental markets. Black sheets are subjected to considerable competition from Belgian products, while the demands from India are restricted. All branches of the tube trade are in need of business.

Iron.

The bar iron trade remains in a state of depression and re-rollers of steel are greatly in need of fresh orders. Bar iron is unchanged in price, and re-rolled steel continues round about £7 7s. 6d. home, and £7 5s. per ton for export.

Pig Iron.

The number of blast-furnaces in operation in Scotland only amounts to ten, but the production is ample to meet all demands in view of the poor position of the consuming trades, and the import into this district of considerable quantities of pig iron from India and the Continent, also on occasions from England.

Scrap.

The market for scrap fluctuates somewhat. For the last week or two weakness has been apparent, and supplies can be secured below the quoted prices of 60s. for cast iron machinery, and 50s. per ton for heavy steel scrap.

Coal.

The coal trade on the whole continues under the influence of unsettled conditions at home and foreign competition abroad. Export inquiries are on restricted lines, but, in any case, shippers are not in a position to quote acceptable terms for forward business in view of the uncertainty existing as to the effect on the market of the Coal Mines Act and colliery schemes. A few orders for delivery before the end of this year have been accepted, but, as a rule, business is of a day-to-day character. Practically all descriptions of round coal are plentiful, and prices a matter of arrangement, the only exception at present being first-class Fifeshire steams. Washed nuts in most districts are comparatively firm. Aggregate shipments amounted to 220,444 tons, against 239,981 tons in the preceding week, and 304,451 tons in the same week last year. The home market is quieter than usual at this time of the year, owing to industrial depression and the throwing on the market of quantities of fuel usually shipped abroad. Consequently, the collieries have not been able to impose the higher prices common to the season of the year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Outlook in the Mining Industry.

ALTHOUGH there have been developments since I wrote a week ago, it cannot as yet be said that the outlook is materially clearer as regards what is going to happen in the coalfield at the end of this month. The Conciliation Board for this district met at Cardiff on Monday, when the report of the joint sub-committee appointed to discuss terms of a new wages agreement was presented; but, apparently, there was nothing definite done and the report of the proceedings was of the usual skeleton character. No details were disclosed as to what demands had been put forward by the respective sides, though it is stated that the coalowners have advanced alternative proposals respecting conditions of employment, based on the one hand on a 7½ hours' day, and on the other on a 90-hour fortnight arrangement. The Board meeting was followed by a meeting of the Executive Council of the South Wales Miners' Federation, when it considered the policy to pursue at the special conference of coalfield representatives which was held on the following day. There were 109 delegates at this conference, at which the president—Mr. Enoch Morrell—explained that their representatives at the Conciliation Board meeting the previous day had put forward proposals for an improvement in the general conditions, including an increase in the minimum percentages and in wages of piece-workers, and the adjustment of the hours of surface workmen. The owners immediately replied that under no consideration would they consider anything that meant increased costs, and intimated that they intended to insist upon very substantial reductions. What the conference did, therefore, was to pass a resolution expressing indignation at the attitude of the coalowners, and to leave in the hands of the Executive Council the conduct of any future procedure, which might become necessary by reason of failure to arrive at a settlement.

Effect on Trade.

The uncertainty, therefore, which still prevails as to what is to take place in the next week or so is very embarrassing to those engaged in the coal export trade, although it can be said that consumers abroad have not shown anxiety as to the position to the extent of coming forward for prompt cargoes of coal in case there is a stoppage of work in the coalfield at the end of the month. It illustrates the general situation prevailing, as it is well known at home and abroad that standing stocks of coal everywhere are very heavy, and that should buyers be cut off from taking supplies from this country they can easily get what they want from continental producers. Perhaps the only direction in which the uncertainty has had any effect is that some shipowners are not sending their steamers to this district in case they may be held up here, while others who have steamers laid up in South Wales ports are taking the precaution of taking bunkers on board so that they can get them away should they be disposed again to put them into commission. Otherwise, the coal market displays no new feature and is comparatively quiet. A certain amount of interest has been shown in contract business, but this has not been very satisfactory so far as this district is concerned. In the case of the inquiry for about 130,000 tons of small coals for the Portuguese State Railways for delivery over the first four months of next year it is now revealed that the railways have only bought about 30,000 tons, which has been divided between three firms here, and the probability is that the railways will come into the market later for fresh tenders. The position so far as the Algerian State Railways' contract for 252,000 tons of patent fuel with the option of 10 per cent. of coal to be delivered over next year, is possibly less satisfactory, as, although part of their coal requirements will come to this district, it is not certain that any of the patent fuel will be placed with South Wales works. About 14,000 tons of fuel may possibly come to this district, but it is far from definite and, considering that in past years the quantity secured has ranged from about 40,000 tons to 100,000 tons, the position is extremely unfortunate. On the other hand, it is understood that purchases have been made of about half a million tons of second Admiralty large and Monmouthshire coals for the Italian State Railways. This is on a f.o.b. basis, and is in accordance with the Hague Agreement to buy 3,000,000 tons of British coals over three years. It cannot, however, be regarded as new business, but, still, is extremely acceptable and will go some way to finding employment in the coalfield. It is reported that the order has been placed with about five undertakings in this district, the coals being for delivery over the first six months of next year.

Tin-plate Minimum Prices Abandoned.

Manufacturers of tin-plates in South Wales came to an important decision at a meeting at Swansea on Tuesday, this being to abandon the principle of minimum prices, which has operated for several years past. The present minimum is 17s. As regards orders, however, it was agreed to continue the quota system. Those manufacturers who are outside the pooling scheme are invited to attend a meeting in London on Friday of this week for the purpose of urging them to come into line, and if this proposal succeeds hopes are entertained of stabilising tin-plate prices, probably on the basis of 16s. to 16s. 3d. per basis box, plus usual extras for qualities and sizes. At a meeting of the South Wales Siemens Steel Trade Association, also held on Tuesday, it was decided to reduce the price of steel bars from £5 15s. per ton delivered to £5.

Steel Trade Items.

On Saturday last the Llanelly Steel Company's works closed down for an indefinite period. These works form one of the largest undertakings of their kind in West Wales, and comprise twelve furnaces and two mills, which, normally, have provided work for about 750 men. For a considerable time past, however, short time has been in force, and for the last fortnight only three furnaces have been in commission. Lack of orders from the tin-plate works has made suspension of work necessary, this being the first occasion on which the steel works have closed down owing to depression since they started in 1904. The position of late has, of course, been aggravated by the heavy importation of foreign steel bars. Failure to come to an agreement regarding proposed new working conditions, resulted in about 1200 to 1300 men abstaining from work at the British Mannesmann Tube Works, Landore, Swansea, on Monday last. These men are members of the Iron and Steel Trades Confederation. The company intimated some time ago its intention of introducing new working conditions involving two longer shifts on five days of the week, instead of three shifts of eight hours over six days; but negotiations with the men resulted in the latter declining the proposals. Last week the company posted the new conditions, together with the new rates of pay, to operate as from Monday last, but the men have persisted in their attitude and declined to present themselves for work.

Engineering Exhibition.

The annual engineering exhibition organised by the South Wales Institute of Engineers opened at Cardiff on Wednesday of last week, and remains open until to-morrow—Saturday. The exhibition was officially opened by the President of the Institute—Mr. G. D. Budge—and throughout has been well attended by members of the various organisations interested in many forms of engineering. The standard of previous exhibitions has been well maintained, and only the limited accommodation available has prevented a more varied display. As it is it has been wonderfully representative, fifty-four firms having their products on view.

Current Business.

There has been no improvement in the general tone prevailing on the steam coal market. Except for sized qualities, supplies of all coals have been rather excessive, and prices have remained at the minima. Anthracite coals are very firm and collieries are well booked up for the remainder of this year. Shipments of coal from this district last week showed some improvement, the total being 533,200 tons, as against 478,000 tons in the previous week. Patent fuel keeps very quiet, and there is no improvement in coke or pitwood.

LAUNCHES AND TRIAL TRIPS.

CORDELIA, oil tanker motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of C. T. Bowring and Co., Ltd.; dimensions, 460ft. by 59½ft.; to carry oil in bulk. Engines, oil, Burmeister and Wain type; constructed by J. G. Kincaid and Co., Ltd., Greenock; launch, October 24th.

ABEILLE 16, twin-screw tug; built by Ferguson Brothers (Port-Glasgow), Ltd., to the order of French owners. Engines, triple-expansion; constructed by the builders; launch, October 29th.

EBANO, single-screw tanker; built by Harland and Wolff, Ltd., to the order of Ebano Oil Company, Ltd.; dimensions, 290ft. by 47ft. by 19ft. 6in.; to carry oil in bulk. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by the builders; trial trip, recently.

PETER HURLL, motor vessel; built by Palmers Shipbuilding and Iron Company, Ltd., to the order of the Standard Shipping Company, New York; dimensions, 520ft. by 70ft. by 28ft. 9in.; to carry petroleum in bulk. Oil engines; constructed by Messrs. Krupp; trial trips, November 3rd and 4th.

BLYTH, single-screw steamer; built by Cammell Laird and Co., Ltd., to the order of the London, Midland and Scottish Railway Company; dimensions, 240ft. by 34ft. by 16ft. 4in.; to carry cargo and horses between Goole and the Continent. Engines, triple expansion, 22in., 36in. and 61in. by 39in. stroke, pressure 200 lb. per square inch; constructed by the builders; launch, November 6th.

ATHELFOAM, single-screw motor tanker; built by Cammell Laird and Co., Ltd.; to the order of United Molasses Company, Ltd.; dimensions, 425ft. by 55ft. by 32ft. 3in. Oil engines; constructed by North-Eastern Marine Engineering Company, Ltd.; trial trip, November 10th.

NORFOLD, motor-driven tanker; built by Barclay, Curle and Co., Ltd., to the order of Messrs. Johan Rasmussen and Co., Norway; dimensions, 420ft. by 58ft. 6in. by 32ft. 3in.; to carry oil in bulk. Oil engines, Barclay, Curle-Doxford type; constructed by the builders; trial trip, November 11th.

PRINCE FAROUK, suction cutter dredger; built by Ferguson Bros. (Port-Glasgow), Ltd., to the order of Tilbury Contracting and Dredging Company (Egypt), Ltd. Engines, triple-expansion; launched complete with machinery aboard, November 12th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DOTT. ING. CAV. UFF. PIERO ALAJMO asks us to announce that he has opened an office at Piazza Duomo, 21, Milan, Italy.

MR. SIDNEY BROWN, who is one of the two vice-presidents of Brown, Boveri and Cie, of Baden, had conferred on him on November 7th, the degree of Doctor of Engineering—*honoris causa*—by the Swiss Federal Technical High School of Zurich.

THE HOWDEN-BUELL COMBUSTION COMPANY, Ltd., of 130–132, Leadenhall-street, E.C. 3, asks us to announce that a working arrangement has recently been entered into between it and the British Rema Manufacturing Company, Ltd., of Halifax, whereby it becomes the sole selling agent for all British Rema mills and manufactures in the British Empire, and requests that, in future, all inquiries regarding such manufactures should be forwarded to it at the address given. Mr. C. P. Walker, A.M.I. Chem. E., who was recently handling the interests of the British Rema Manufacturing Company, Ltd., in London and in the South of England, has been appointed to the charge of the crushing and grinding department of the Howden-Buell Combustion Company, Ltd.

BRIDGES.—A beautifully produced volume bearing the title "Bridges: A Few Examples of the Work of a Pioneer Firm in the Manufacture of Steel and Steelwork," has been sent to us by Dorman, Long and Co., Ltd. It opens with an admirable picture and a few notes about the Sydney Harbour bridge, and continues with a full description of the design and erection of the New Tyne bridge at Gateshead, the construction of which has not inaptly been regarded as the dress rehearsal for the building of the great bridge at Sydney—the largest steel-arched bridge in the Empire. Then there follow descriptions of bridges in Egypt, the Sudan and India, and finally some account is given of the old and the new Lambeth bridge, which is now under construction. The photographic reproductions are real works of art, and the whole volume is a very desirable one.

THE INSTITUTION OF AUTOMOBILE ENGINEERS.—How seldom, after an Institution dinner, can one lay one's hand upon one's heart and say "I'm sorry that's over"? But so it was on Wednesday night, when the Institution of Automobile Engineers gave their annual banquet at the Park Lane Hotel. There were no speeches, or, to be precise, there was but one—of two minutes—by the President, Sir Herbert Austin, who welcomed the guests. Our recollections of it are a little bit hazy, but we cannot remember that the guests were mentioned in it. But it was a good speech and called for no replies. Everything was scheduled and there was a two-faced clock to keep us to the programme. Ah! such a clock. It refused to take its Kew from the sun, but by the manipulations of a *deus ex machina* in a red coat kept pace with the proceedings—like a sleepy conductor following the orchestra he is supposed to lead. That clock will live in our memories. A clock that for all the Jeans's and Einsteins in existence proclaimed that man was the master of his destiny and not the mere slave of the fourth dimension. Then there was singing, and laughter, and, in the wings the occasional bursting of a balloon; good fellowship, movement, happiness, and at the end the muse of the many twinkling feet—scheduled, it is true, to the minute, yes, but by that complacent clock. A great evening, a great success. Mr. Basil Joy has our congratulations on the destruction of precedent and the introduction of a more joyous way.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/9 to 20/6
(1) Spanish	20/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0	—
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 11 6	3 11 6
Cleveland—		
No. 1	3 6 0	3 6 0
Siliceous Iron	3 6 0	3 6 0
No. 3 G.M.B.	3 3 6	3 3 6
No. 4 Foundry	3 2 6	3 2 6
No. 4 Forge	3 2 0	3 2 0
Mottled	3 1 6	3 1 6
White	3 1 6	3 1 6
Midlands—		
(c) Staffs.—	*(Delivered to Station.)*	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—	*(Delivered Sheffield)*	
No. 3 Foundry	3 6 0	—
Forge	3 3 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast— N. Lancs. and Cum.— Hematite Mixed Nos.	4 3 6 (a) 4 5 6 (b) 4 10 6 (c)	— — —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 15 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	11 15 0	11 12 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
Manchester—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 7 6	—
Sheffield—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	10 5 0	—
Soft Wire Rods	8 0 0	—
Midlands—		
Small Rolled Bars	7 12 6 to 8 10 0	—
Billets and Sheet Bars	5 15 0 to 6 5 0	—
Galv. Sheets, f.o.b. L'pool	11 12 6	—
(2) Staffordshire Hoops	10 0 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	16/3 to 17/–
Block Tin (Cash)	113 5 0
„ (three months)	114 10 0
Copper (cash)	47 12 6
„ (three months)	47 12 6
Spanish Lead (cash)	15 17 6
„ „ (three months)	15 17 6
Spelter (cash)	14 16 3
„ (three months)	15 6 3
Manchester—	
Copper, Best Selected Ingots	50 10 0
„ Electrolytic	51 10 0
„ Strong Sheets	84 0 0
„ Tubes (Basis Price), lb.	0 1 0
Brass Tubes (Basis Price), lb.	0 0 10½
„ Condenser, lb.	0 1 0½
Lead English	17 12 6
„ Foreign	16 5 0
Spelter	15 2 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

		Per Unit.
Tungsten Metal Powder	2/6 per lb.	
Ferro Tungsten	2/3 per lb.	
	Per Ton.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 5 6	7/–
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/–
„ „ „ 1 p.c. carbon	£38 0 0	13/–
„ „ „ 0·70 p.c. carbon	£41 0 0	14/–
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 5 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£18 0 0 scale 7/– per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	13/9
„ „ Splint	14/– to 15/3
„ „ Trebles	12/6
„ „ Doubles	12/–
„ „ Singles	11/– to 11/3
Ayrshire—	
(f.o.b. Ports)—Steam	13/–
„ „ Jewel	16/–
„ „ Trebles	13/–
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/– to 12/–
Screened Navigation	16/6 to 17/6
Trebles	13/6 to 16/–
Doubles	12/6
Singles	11/–
Lothians—	
(f.o.b. Leith)—Best Steam	11/–
Secondary Steam	10/9
Trebles	13/3
Doubles	12/– to 12/3
Singles	10/9 to 11/–

ENGLAND.

	Export.
(8) N.W. Coast—	
Steams	20/6 to 21/–
Household	32/6 to 53/6
Coke	21/– to 22/–
Northumberland—	
Best Steams	13/6
Second Steams	12/–
Steam Smalls	10/– to 10/6
Unscreened	12/6
Household	25/– to 37/–
Durham—	
Best Gas	14/9 to 15/–
Second	12/9 to 13/–
Household	25/– to 37/–
Foundry Coke	24/– to 26/–

Sheffield—	Inland.	Export.
Best Hand-picked Branch	25/6 to 27/–	—
Derbyshire Best Bright House	20/– to 22/6	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	17/6 to 19/–	—
„ „ Nuts	14/6 to 16/6	—
Yorkshire Hards	14/– to 15/6	—
Derbyshire Hards	14/– to 15/6	—
Rough Slacks	8/6 to 9/–	—
Nutty Slacks	6/6 to 7/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	11/– on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b. 16/6 to 17/–		

Cardiff— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	20/–
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/6 to 17/7½
Best Steam Smalls	13/3 to 13/6
Ordinary Smalls	11/6 to 12/9
Washed Nuts	17/6 to 21/6
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	16/– to 16/6
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	27/6 to 35/–
Furnace Coke (Export)	17/6 to 20/–
Patent Fuel	21/6
Pitwood (ex ship)	24/9 to 25/–
Swansea—	
Anthracite Coals:	
Best Big Vein Large	35/– to 37/6
Seconds	27/– to 31/6
Red Vein	23/6 to 27/–
Machine-made Cobbles	41/6 to 45/–
Nuts	40/– to 46/–
Beans	24/6 to 28/–
Peas	21/– to 21/6
Breaker Duff	9/9 to 10/3
Rubbly Culm	9/– to 9/6
Steam Coals:	
Large	19/6 to 21/6
Seconds	18/– to 19/6
Smalls	12/– to 13/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 12/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our Correspondent in Paris.)

Wages Reduction.

In the engineering and metallurgical industries on the Continent there is a growing belief that the situation can only be saved by a general readjustment of values, which means that wages must be reduced and selling prices lowered, so as to bring them down to the level of the wage-earning capacity of the community. All other attempts to deal with the situation have failed. There is something fundamentally wrong, and it is assumed that there can be no recovery without a reduction of living costs to the level of the wages of the great mass of workers outside the more favoured industries. That is the principle adopted in Germany where wages in the engineering trades have been reduced, and the example has now been followed in the iron and steel trades in Belgium, where there is less unemployment than in any other country except France. The national arbitration commission in Belgium has decided on a wages reduction of 5 per cent. The same thing is being done in the Saar, in Italy, and in Poland, and there is every indication that it will extend, for it is obvious that cheaper production in those countries will have serious consequences for manufacturers elsewhere who are unable to benefit from cheaper labour. It was only to be expected that the men should have resisted these wage reductions, but the inevitable reaction against high wages during a time of trade depression is too strong for them. This movement in the chief producing countries is beginning to weigh upon opinion in France, where the necessity of a readjustment of wages has not been felt to the same extent as in other countries; but now that French manufacturers are feeling the pinch, the idea is gaining ground that something must be done to bring down costs. For the moment, French manufacturers are looking hopefully to the distribution of an abundance of work on account of the public works to be undertaken at home and in the Colonies, but that will not compensate for a loss of foreign trade and a general decline in industrial activity.

Shipbuilding.

The launching of a motor ship for the Messageries Maritimes was made the occasion of a vigorous protest against the existing state of things which is regarded as disastrous for the French shipbuilding industry. After all that has been done to help builders, the situation has shown no improvement. It is indeed becoming steadily worse, and more slips are idle, while the yard at Boulogne of the Chantiers Naval de Pas de Calais has been closed. It is now affirmed that the remedies applied are inefficient so long as the industry suffers from a foreign competition which is stigmatised in stronger terms than have yet been used in this connection. Statements have been made to the effect that some foreign shipyards are subsidised to enable them to tender for French orders at below cost. The object of this agitation is obviously to induce the Government to give additional protection to shipbuilders, but it is doubtful whether it can do more than it has already done, for its hands are tied by the necessity of protecting the interests of shipowners who must be able to purchase ships on the same terms as their foreign competitors.

Local Railways.

All the Departments are seriously concerned as to what is to be done with local railways. They are all being worked at a heavy loss, and although that loss is partly covered by State subsidies, the greater part of the burden falls upon the Departments, which are considering the ways and means of avoiding the deficits. As the local railways are unable to pay their way, the most obvious remedy would appear to be to replace them with motor services. One objection to that solution is that the Departments would be deprived of the State subsidies, and another is that the cost of road maintenance would possibly still leave the services unprofitable. The idea, however, has not been abandoned, but it will not come up for consideration until all means of making the best of the existing railways have been fully explored. Complete data upon the working of the local railways are now being collected for the preparation of a report which will deal with the whole question in the hope that some practical suggestions may be put forward to save the railways. The running of motor coaches has not improved the situation to any great extent, and it is objected that they depend upon a fuel that may increase largely in cost in the future. One solution is to employ coaches with storage batteries which can be recharged very cheaply during the night in those districts where the system of rural electrical distribution has been completed.

Energy from the Rhine.

The first power station on the Alsace Canal will be put in operation with the opening of the first section of the canal at Kembs less than two years hence. It was expected that the construction of that canal would have prevented the Germans from carrying out their scheme to canalise the Rhine, chiefly because it was supposed that the advantages offered to navigation by the canal would considerably diminish the value of the works for improving navigation on the river between Strasburg and Basle, and the French further claimed that the energy produced by the Rhine would not suffice to make the venture pay. Nevertheless, since the Baden and Swiss Governments undertook to carry through the scheme, which provides not only for an improvement in the Rhine navigation, but also for the construction of a number of power stations between Basle and Schaffhausen, the hydro-electric works have been pushed forward with a great deal of vigour. Between Schaffhausen and Birsfelden the Rhine has a fall of 160 m. over a distance of 123 kiloms., and of the 603,000 kW available, 255,000 kW are already produced by four stations. The French fear that this will absorb some of the custom that was anticipated for the electrical supply of the Alsace Canal.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

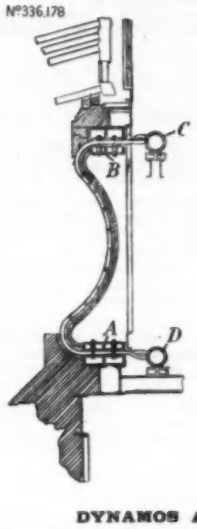
When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

N°336,178



336,178. January 2nd, 1930. — Radiant Heat Superheaters, *Babcock and Wilcox, Ltd., Farringdon-street, London, E.C.* 4.

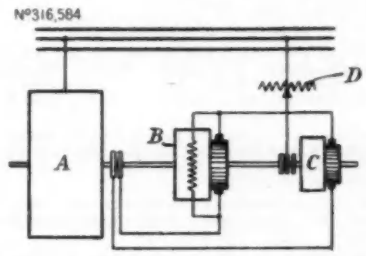
This superheater is arranged to form part of the walls of the furnace of a boiler. Its peculiarity lies in the fact that the tubes are anchored rigidly in the blocks A and B before they enter the headers C and D. They are also curved to accommodate expansion and contraction. The drawings indicate tubes of rectangular section, although this form is not actually specified. It will be seen that by these means the joints, where the tubes are expanded into the headers, are relieved of all stress due to the movement of the tubes as they expand and contract with changes of temperature.—*October 9th*, 1930.

DYNAMOS AND MOTORS.

316,584. July 30th, 1929.—Synchronous or Asynchronous Wattless Output Machines, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification describes an arrangement for the excitation of synchronous or asynchronous wattless output machines used for potential regulation and phase compensation. A is a synchronous wattless output machine with which the D.C. exciting machine B, of the usual self-exciting type, is mechanically coupled. In the current circuit between the commutator of the machine B and the field winding in the rotor of the machine A a rotary converter C is connected with the commutator

N°316,584



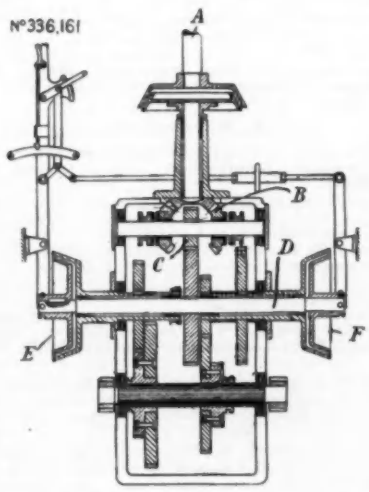
side, the slip rings of which are connected to the mains through a regulating transformer D, and which consequently injects into the circuit of the field winding of the machine A a direct potential proportional to the mains potential. The potentials of the machines B and C are opposed, so that the potential of the machine B being the greater, it creates the energising current. Accordingly, on the occasion of a drop in the mains potential, the excitation of the machine A will be strengthened, and thus be enabled to give a greater output of wattless current, which will operate against a further fall of the mains potential. The stator of the rotary converter C can be provided with a compensation winding supplied with D.C.—*October 16th*, 1930.

TRANSMISSION OF POWER.

336,161. December 12th, 1929.—Change Speed Gearing, Motorenfabrik Deutz Aktiengesellschaft, Cologne-Deutz, Germany.

The broad principle aimed at in this invention is that there

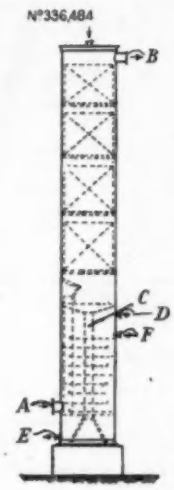
N°336,161



should be no appreciable cessation of the transmission of power during the process of changing gears. The driving shaft is shown at A, with a normal clutch. The double mitre gearing B provides for a reverse on the pinion C. This pinion drives the shaft D, from which either one of the two change gears can be driven through the clutches E and F. The process of gear-changing is not specified very exactly, but it appears that it is effected during the almost simultaneous engagement and disengagement of those two clutches.—*October 9th*, 1930.

GAS PRODUCERS.

N°336,484



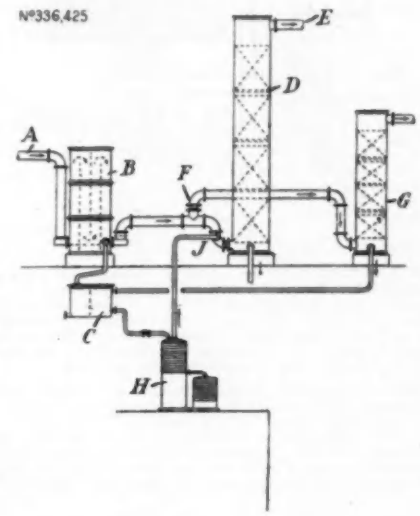
336,484. November 27th, 1929. —A Process for the Final Cooling of Gases from Coal Distillation Ovens, H. Koppers Aktiengesellschaft, 29, Moltkestrasse, Essen, Ruhr, Germany.

The object of this invention is to avoid the clogging of gas coolers used in connection with by-product recovery plant with naphthaline. The gas enters the tower at A and passes out at B. It is subject to a washing with water in the upper part of the tower. This water falls down the dip pipe C and finally escapes at D. At the same time tar is supplied at F, passes down through the trays of the tower and is discharged at E. This tar dissolves and washes away the naphthaline which might otherwise accumulate and clog up the apparatus.—*October 16th*, 1930.

336,425. October 12th, 1929.—The Purification of Gases Containing Sulphuretted Hydrogen and Ammonia, Dr. F. Bönnemann, Schnutnenhausstrasse 54, Essen-Ruhr, Germany.

The aim in this plant is the maximum recovery of sulphur and ammonia when coal high in sulphur is being coked. The gas enters the apparatus at A and passes through a cooler B in which some of the ammonia is deposited, to be collected in the tank C. The cooled gas goes on to the scrubber D, where chemical

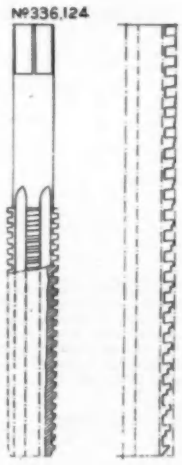
N°336,425



reaction takes place between the ammonia and sulphuretted hydrogen, towards their complete elimination from the gas, which is drawn off at E. There may, however, be an inappropriate proportion of the two gases to be recovered, so a certain proportion of the main supply is by-passed at F and is treated in a separate tower G. Any ammonia resulting from this treatment is returned to the tank C and combined with that coming from the cooler B is distilled at H. The resulting ammonia gas is added to the main stream at J.—*October 16th*, 1930.

MACHINE TOOLS AND SHOP APPLIANCES.

N°336,124



336,124. October 30th, 1929. —Screw-cutting Taps, M. Hübner, 10, Unteri Dresdenerstrasse, Freital, Germany.

A bold claim, but one confined to square threaded screws. The inventor makes a claim for "a tap serving as intermediate or finishing cutter for square screw threads, characterised in that the peripheral cutting face of each of the teeth on its taper portion is stepped, so that in operation each of the said teeth will cut the material in at least two strips of the total thickness of the tooth, thereby reducing the cutting strain and avoiding undue heating." The process of carrying out the invention is obvious in the drawing.—*October 9th*, 1930.

335,578. June 26th, 1929.—Screw-cutting Tools, Standard Telephones and Cables, Ltd., and G. W. Clarke, Colombia House, Aldwych, London, W.C. 2.

The inventors claim that this tap is capable of cutting a thread

more true to size than the ordinary fluted tap. It has only one cutting edge, which is formed by grinding away a tapered land with a diagonal face, as shown. The result is that the cutting

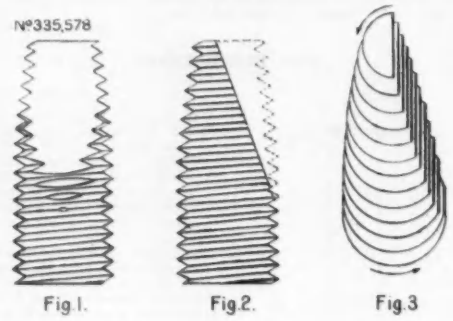


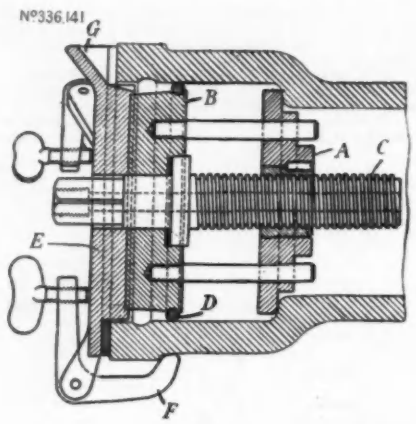
Fig.1. Fig.2. Fig.3

edge of each thread gradually decreases in angle, as shown in Fig. 3, until there is merely a burnishing action. A similar principle is used for dies.—*September 26th*, 1930.

MISCELLANEOUS.

336,141. November 23rd, 1929.—A BLANK FLANGE FOR PIPE TESTING, H. J. W. Ljungberg, Jönköping, Sweden.

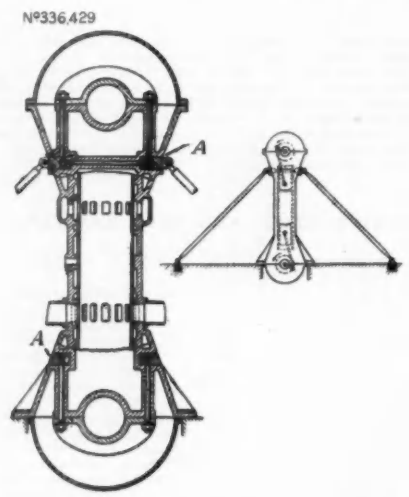
This device is intended for the closure of spigot and socket pipes during hydraulic testing. It comprises two plates A and B which can be forced apart by the screw C. The plate B is furnished with a packing gasket D. There is a further plate E,



which is held in place by the clamps F. In service the apparatus is assembled as shown and molten lead is poured in at G. The plate E is then removed and the plate B forced outwards by means of the screw C. On account of its conical form this action tightens the lead seal against internal pressure. The device is released by slacking back the screw C and knocking in the plate B, when the lead is easily removed.—*October 9th*, 1930.

336,429. October 14th, 1929.—A DEVICE FOR TAKING UP THE STRESS OF BOLTS ON ENGINE CASINGS, H. Junkers, 21, Kaiserplatz, Dessau, Anhalt, Germany.

In this specification it is explained that if the crank shaft bearing caps are held in place by long through bolts reaching to the cylinder head these bolts are inconvenient to arrange. The alternative of using tap bolts in a light alloy casting has the



objection that the threads do not have sufficient bearing surface to carry the stress on the soft metal. As a consequence the inventor screws tap bolts into what might be described as slugs A A carefully fitted into recesses in the crank case. It is noteworthy that the illustrations show an opposed-piston engine with two crank shafts and that, as is indicated by the small sketch, it is stayed by diagonal struts.—*October 16th*, 1930.

INSTITUTE OF TRANSPORT.—At a recent meeting of the Council of the Institute, Mr. J. Milne, C.S.I., general manager of the Great Western Railway, was elected a member of Council, and Mr. W. V. Wood, a vice-president of the London, Midland and Scottish Railway, was appointed Honorary Librarian of the Institute.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

CHELSEA POLYTECHNIC.—Manresa-road, London, S.W. 3. Prize distribution and address by her Grace the Duchess of Atholl. 8 p.m.

DIESEL ENGINE USERS ASSOCIATION.—In Caxton Hall, Caxton-street, Westminster, London, S.W. 1. "The Application of Diesel Engines to Road Transport," by Major W. H. Goddard. 3.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—In the Chamber of Commerce, New-street, Birmingham. An informal discussion will be opened by Mr. Cecil H. Bailey on "The Effect of Mining on Surface Structures." 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: METER AND INSTRUMENT SECTION.—At the Florence Restaurant, 56, Rupert-street, London, W. 1. Dinner. 6.45 for 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. General meeting. "The Coefficients of Heat Transfer from Tube to Water," by Mr. A. Eagle and Mr. R. M. Ferguson. 6 p.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS.—Lecture Hall, Surveyors' Institution, 12, Great George-street, Westminster, S.W. 1. "Some of Our Road Problems," by Colonel C. H. Bressey. 5.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Ancient Clocks and Horological Curiosities," by Mr. R. P. Howgrave Graham, illustrated by slides and exhibits. 7.30 p.m.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. Meeting at 5 p.m. Editing Committee meeting, 3.30 p.m. Council meeting, 4 p.m.

TO-DAY AND SATURDAY, NOVEMBER 22ND.

SOUTH WALES INSTITUTE OF ENGINEERING.—Drill Hall, Dumfries-place, Cardiff. Exhibition.

SATURDAY, NOVEMBER 22ND.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. "Machining Allowances on Castings," by Mr. S. W. Wise. 6.30 p.m.

MONDAY, NOVEMBER 24TH.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION, LONDON.—Storey's-gate, St. James's Park, London, S.W. 1. "Machine Tools," by Mr. C. H. Russell. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Cantor Lecture, "Modern Domestic Scientific Appliances," by Professor C. R. Darling. 8 p.m.

TUESDAY, NOVEMBER 25TH.

DESIGN AND INDUSTRIES ASSOCIATION.—At the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Discussion, "Modern Electric Lighting and Lighting Fixtures." Speakers, Mr. R. D. Best and Mr. Raymond McGrath. 8 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Ordinary meeting. Paper to be further discussed, "The Lochaber Water Power Scheme," by Mr. W. T. Halcrow. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: MIDLAND BRANCH.—Queen's Hotel, Birmingham. Dinner to meet the President. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "The Development of Air Communication in Africa," by Mr. G. E. Woods Humphery. 4.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Preparation of Standard Steels," by Mr. G. C. Waite. 7.30 p.m.

TUESDAY AND WEDNESDAY, NOVEMBER 25TH AND 26TH.

INSTITUTION OF GAS ENGINEERS.—In Incorporated Accountants' Hall, Victoria Embankment, W.C. 2. Autumn research meeting. 10.15 a.m. each day.

WEDNESDAY, NOVEMBER 26TH.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Joint meeting with the Association of Supervising Electrical Engineers. Magnet House, Kingsway, W.C. 2. "Ventilation by Air Movement," by Mr. H. J. Eley. 7.15 p.m.

NEWCOMEN SOCIETY.—Caxton Hall, Westminster, S.W. 1. Annual general meeting. "Early Fire Extinguishing Engines," by Mr. Rhys Jenkins. 5.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Tees-side Branch, Graduate Section. "Further Aspects of Boiler Design," by Mr. O. E. Fletcher. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "The Chemical Constitution of Coal," by Professor W. A. Bone, F.R.S. 8 p.m.

THURSDAY, NOVEMBER 27TH.

BRITISH CHEMICAL PLANT MANUFACTURERS' ASSOCIATION.—Jules Restaurant, Jermyn-street, London. Annual dinner. 7 for 7.30 p.m.

CO-ORDINATING COMMITTEE REPRESENTING STAFFORDSHIRE IRON AND STEEL INSTITUTE, BIRMINGHAM METALLURGICAL SOCIETY (INC.), BIRMINGHAM LOCAL SECTION OF THE INSTITUTE OF METALS.—In Room No. 7, the Chamber of Commerce Buildings, Birmingham. "Solders," by Mr. O. F. Hudson. 7 p.m.

FRIDAY, NOVEMBER 28TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "Export Trade Emancipation," introduced by Mr. Edward Batten. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Scottish District meeting at County Buildings, Paisley. Address by Mr. Thomas Somers on the Sixth International Road Congress at Washington, D.C. 2 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Photography Applied to Science," by Mr. G. H. Willett. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne. "The Ocean-going Tramp Steamer from the Owner's Point of View," by Mr. W. Stanley Hinde. 6 p.m.

SATURDAY, NOVEMBER 29TH.

CO-ORDINATING COMMITTEE REPRESENTING STAFFORDSHIRE IRON AND STEEL INSTITUTE, BIRMINGHAM METALLURGICAL SOCIETY (INC.), BIRMINGHAM LOCAL SECTION OF THE INSTITUTE OF METALS.—In the Queen's Hotel, Birmingham. Reception, 6.30 to 7 p.m.; dinner, 7 p.m.

MONDAY, DECEMBER 1ST.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Cantor Lecture, "Modern Domestic Scientific Appliances, Lecture II.," by Professor C. R Darling. 8 p.m.

TUESDAY, DECEMBER 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, W.C. 2. "Some Experiments on the Factors Affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are Locked," by Mr. J. Bradley and Mr. S. A. Wood; "Factors Affecting the Behaviour of Rubber-tired Wheels on Road Surfaces," by Mr. J. Bradley and Mr. R. F. Allen. 7.45 p.m.

THURSDAY, DECEMBER 4TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—At the Queen's Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—Engineers' Club, Albert-square, Manchester. Annual dinner. 6.30 for 7 p.m.

FRIDAY, DECEMBER 5TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Extra general meeting. "Machinery and Methods of Manufacture of Sheet Glass," by Professor W. E. S. Turner. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Oil Burning for Domestic Central Heating," by Mr. R. L. Mayston. Slides. 7.30 p.m.

MONDAY, DECEMBER 8TH.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—Goldsmiths' Hall, London, E.C. 2. Imperial College dinner. 7 p.m. for 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Cantor Lecture, "Modern Domestic Scientific Appliances, Lecture III.," by Professor C. R. Darling. 8 p.m.

FRIDAY, DECEMBER 12TH.

JUNIOR INSTITUTION OF ENGINEERS.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. Presentation of awards by Sir Ernest Moir and induction of new President, Colonel Sir Henry George Lyons, F.R.S. Presidential address, "Technical Museums and their Value to Engineers." 7.30 p.m.

1931.

WEDNESDAY, MARCH 25TH, 1931.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—At the Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. "George Stephenson's Institute and its Library." 7 p.m.

CONTRACTS.

THE GENERAL ELECTRIC COMPANY, Ltd., of Magnet House, Kingsway, W.C. 2, has received an order for twelve car sets of electrical equipment for use on the tramways of the Auckland Transport Board. Each set is to consist of four tramway motors, type W.T. 28 A.L., each developing 40 B.H.P. at 500 volts on the one-hour rating, one set of resistances, lightning arrester and choke coil.

INTERNATIONAL COMBUSTION, Ltd., of Africa House, Kingsway, London, W.C. 2, has received from the Electricity Supply Commission of Johannesburg, an order for the supply of new boiler plant in connection with the installation of further electrical generating equipment at the Congella Power Station, Durban. The plant will comprise two standard Combustion steam generators of 100,000 to 120,000 lb. per hour evaporation at 270 lb. per square inch pressure and 700 deg. Fah. final temperature, complete with Lopulco pulverised fuel firing equipment.

THE STIRLING BOILER COMPANY, Ltd., 32–33, Farringdon-street, London, E.C. 4, has received an order for steam-raising plant to be installed at the new Orsted Power Station of the Copenhagen Municipal Lighting Department. The plant will comprise eight tri-drum Stirling boilers, with a combined normal evaporative capacity of 844,800 lb. of water per hour, and an overload capacity of 1,244,800 lb. per hour. The working pressure is to be 356 lb. per square inch, and the final steam temperature 752 deg. Fah. The order also includes mechanical stokers, Bailey walls, air heaters, economisers, forced and induced draught plant, &c. The foregoing constitutes what is believed to be the largest order for steam-raising plant ever placed in Denmark.

THE GREAT WESTERN RAILWAY COMPANY announces that the following orders, in order of value, have been placed:—(*a*) Supply and delivery of one hundred and eight 1½-2-ton goods chassis, Dennis Bros., Ltd., Guildford, Surrey; (*b*) filling in part of Prince of Wales Dock lock and construction of dock wall across inner entrance to lock at Prince of Wales Dock, Swansea, Topham, Jones and Railton, Ltd., London; (*c*) new Invoice Office, Paddington Goods Yard, Wm. T. Nicholls, Ltd., Gloucester; (*d*) reconstruction of the Eign Bridge, carrying the line over river Wye on the Grange Court to Hereford line, Geo. Palmer, Neath; (*e*) reinforced concrete work to carry a new coal hoist track and traverser track at North Dock, Alexandra Docks, Newport, Lotz and Kier, Stoke-on-Trent; (*f*) supply and delivery of eighteen 35 cwt. to 40 cwt. Morris vans, the Morris Garages, Ltd., Oxford; (*g*) supply and erection of electrically-driven centrifugal pumping plant for impounding service at South Dock Basin, Swansea, Gwynnes Pumps, Ltd., London; (*h*) supply and erection of one electric 30-ton Goliath crane, Morpeth Dock, Birkenhead, Clyde Crane and Engineering Company, Ltd., Mossend, Lanarkshire; (*i*) rebuilding old Station Inn at Taplow, H. D. Bowyer, Slough; (*j*) supply and erection of one 20-ton electrically driven Goliath crane, Wolverhampton, Herbert-street Goods Yard, Clyde Crane and Engineering Company, Ltd., Mossend, Lanarkshire; (*k*) supply and delivery of one rigid six-wheel 10–12-ton chassis, John I. Thornycroft and Co., Ltd., London; (*l*) work to be performed in connection with the annual Board of Trade Survey for the renewal of the passenger certificate of the twin-screw steamer "Great Western," Thos. Diamond and Co., Ltd., Cardiff; (*m*) supply and delivery of six petrol-driven platform trucks for Bristol, Douglas Motors, Ltd., Bristol; (*n*) one 4 to 5-ton goods chassis, complete with cab, pneumatic tires and power take-off, John I. Thornycroft and Co., Ltd., London; (*o*) supply and erection of one 6-ton hydraulic jib crane for Smithfield Market, Hollings and Guest, Ltd., Birmingham; (*p*) supply and erection of element for ammonia condenser for cold stores, Queen Alexandra Dock, Cardiff, The Farringdon Works, and H. Pontifex, Ltd., London; (*q*) work to be performed in connection with the renewal of the Board of Trade passenger certificate of the steam tender "Sir Richard Grenville," Bickle Engineering Company, Ltd., Plymouth; and (*r*) supply and delivery of five complete Ford trucks, R. Pratt, Ltd., Sutton, Surrey.